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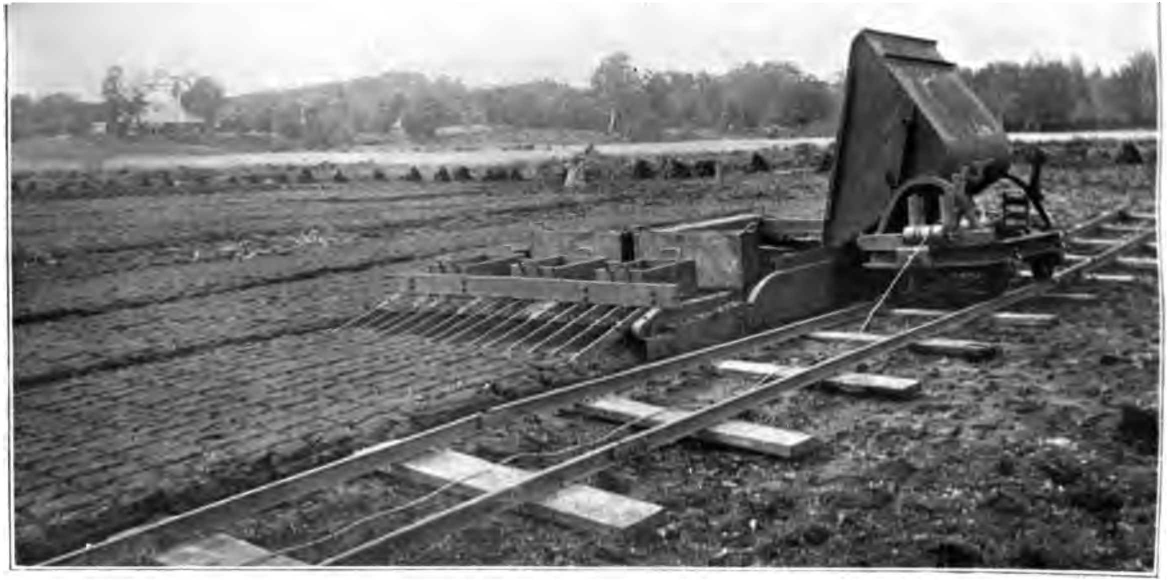

Jacobsson's Field Peat Press at work at St. Olof's Peat Bog, Sweden. (For description see p. 39.)

PEAT:

ITS USE AND MANUFACTURE.

BY

PHILIP R. BJÖRLING

AND

FREDERICK T. GISSING.

With Sixty Illustrations.

LONDON:
CHARLES GRIFFIN & COMPANY, LIMITED,
EXETER STREET, STRAND.
1907.

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PREFACE.

WHILST peat may be used for a great variety of purposes, all of which find place in this volume, its chief importance at the present time is as a source of fuel. Its great bulk as compared with coal and its high percentage of water have, however, hitherto proved obstacles to its extended use. For many years past endeavours have been made to find a practical means of overcoming these obstacles, and it is probable that some, at least, of the investigators who have been working at the problem will eventually prove successful in pointing out the way to utilise the immense quantities of energy now lying dormant in the form of peat.

In the preparation of this volume, which is the outcome of a suggestion made by the late Sir Clement Le Neve Foster, who placed valuable notes at our disposal, it has been the author's aim to describe the principal methods and classes of machinery that have from time to time been adopted for utilising peat, reference being made not only to the successful, or at least partially successful, methods, but also to several failures, with a view to prevent future investigators from working on similar lines.

It will be noticed that almost every method described is based upon the principles of drying the peat by air, by artificial heat, or by pressure. Both in theory and in practice the application of these principles is open to the objections that the peat has to be handled too many times, which greatly increases the cost of treatment, and that the state of the weather at the time has considerable influence. If the peat is compressed after drying, the cost of production is further increased. The only satisfactory method for the economical conversion of peat into a fuel for domestic and manufacturing purposes appears to be to take it direct from the peat bog and on no account to handle it before it is ready for transport, burning, or charring, except by machinery of some description. In no case must artificial heat be employed in the drying. This operation has always proved the chief difficulty. On account of the evaporation of the volatile gases and of the bituminous matter contained in the peat, heat detrimentally affects its calorific value. Pressure has been tried, but without success, because it hardens the outside crust so that the centre of the block contains water that cannot be removed before the fuel is burned. It is perfectly easy to reduce the proportion of water to 20 per cent., but in order to produce a satisfactory fuel, it must be reduced to not more than 7 per cent.

A bibliography has been appended, giving a list of the various original sources of information consulted, and also a list of patents relating to peat since the year 1899.

The manuscript was nearly completed when Mr Björling died, and thanks are due to the publishers for their valuable help in carefully editing the uncompleted manuscript, to Mr [illegible] Beckett, A.M.I.C.E., for examining the proofs of the engineering portion of the work, to Mr William Dixon, and to the following firms, who have kindly supplied information and lent photographs or electros:—A. B. Lennox, C.E., the Åbjörn Anderssons Mekaniska Verkstads Aktiebolag, and the No. 1 Peat-Coal Syndicate, Ltd.

FREDERICK T. GISSING.

March 1907.

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PEAT.

CHAPTER I.

FORMATION, GROWTH, AND DISTRIBUTION.

As to the antiquity of the use of peat, or turf, as fuel there can be but little doubt. This spongy substance may be found in almost every temperate country, and especially in Northern Europe, and the land on which it is found is termed a "peat-bog." These bogs are of vegetable origin, and from time to time vast changes have been wrought in their formation and growth.

Various opinions have been brought forward as to the actual nature of peat. Degner,[1] a Dutch author, thought that all peat had been formed by the roots, stems, and leaves of aquatic plants. This is mostly the case with the peat in those parts of Holland to which Degner's observations were chiefly confined. It has been conjectured that the formation of these peat-bogs was, in the early stages of man, coeval with the interruption which took place on the surface of the earth and produced hills and dales.

Scheuchzer was of opinion that peat was only a fossil bituminous earth, and only mixed accidentally with vegetable substances.

---

[1] Degnerus, *De Turfis*, 8vo.

By many it was supposed that the peat-bogs were produced by bituminous matter received from the sea by the destruction of floating islands previous to the existence of our present fixed continents and islands.

Dr Morton thought that the peat strata in Northamptonshire and other parts of England, with all the trees they contain, had been deposited by the universal deluge of the world.

Again, some scientists went so far as to say that these peat-bogs consisted of organic living substances still growing, but light thrown on the matter by means of careful scientific investigations has conclusively proved that all the above theories are incorrect.

From minute observations it has been ascertained that peat in its natural state consists of aquatic plants, sedges, reeds, rushes, mosses, etc., in different stages of decomposition, and judging from the appearance of the localities in which the peat formation abounds, its presence may be accounted for in the following manner:—

Peat represents one of the phases in the slow decay of vegetable matter. It may be formed in various ways. The changes which plants pass through before and after death are generally similar, and take place for the most part in the same order. During growth the interior walls of the cells are gradually coated with matters which ultimately become so thick as to impede the free transpiration of oxygen and aqueous vapour, the result of which is a lowered vitality and finally death of the cell. At this stage the plant generally begins to decompose, the contents of the cell disappearing first, then the cell wall, and, lastly, the spiral fibres. These steps are marked by characteristic chemical changes. The retention of oxygen in the compounds at the time of death promotes fermentation, especially of the nitrogenous substances which yield ammonia, sulphuretted hydrogen, and phosphuretted hydrogen. The non-nitrogenous substances, such as the sugars and starches, are converted into the various acids generally yielded by decaying vegetable matter. In course of time the cells become so distended with the products of decomposition that their walls burst and the various gaseous compounds escape. With this new condition of things the further chemical changes assume a different character, and the still unaltered vegetable matter is converted into humic and allied acids and carbonic acid, while the soluble compounds slowly pass away in solution. The final result is that the cell is emptied of its contents and deprived of its green colour if it originally contained chlorophyll. The next stage consists of the decomposition of the cell wall, which proceeds more or less rapidly according as it is or is not incrusted with sparingly soluble lime salts, silicates and resinous matters, and according to the strength of the vegetable acid solutions in which it is immersed. By the evolution of oxygen, aqueous vapour, and carbon dioxide, there results a mass which contains a large and increased proportion of carbon, a little hydrogen and a little oxygen in a combined form, generally as a yellow brown ulmin, but often this is subsequently converted by oxidation into the light brown humin. At this stage the vegetable matter is mainly a mixture of ulmin, humin, and spiral fibres.

The last stage, the destruction of the spiral fibres and more resistant tissue, is much assisted by the combined actions of frost and moisture. Frost disintegrates the fibres, and the black mould-like substance absorbs so much water that it becomes waterlogged and sinks to the bottom of the pool or liquid it is in. With the accumulation of this matter it becomes subjected to pressure, to slow carbonisation, and to permeation by bituminous and resinous substances, and after a time becomes what is known as peat.

The formation of peat is dependent upon a special combination of climatic and topographical conditions. The principal factors are: (1) The growth of aquatic and moisture-loving plants, more particularly those that do not produce flowers; (2) a soil or subsoil which will retain water at the surface; (3) sufficiently humid atmosphere to prevent too rapid evaporation; (4) a temperature high enough to allow of a profuse growth of vegetation, yet low enough to check too rapid a decay of vegetable matter.

Most bogs are mainly formed of species of *Sphagnum*, but in some this genus is comparatively rare. Thus in Ireland the principal moss of the higher mountain bogs is *Thacomitrum lanuginosum*; in the more southern parts of South America and contiguous islands the peat is mainly formed of *Astelia pumilum* and *Donatia magellanica*. The general character of the flora is similar in all parts of the world, but in each continental area there are a few species restricted to it, and some species common in one part of it may be rare in another part. For instance, *Paludella squarrosa*, *Arbutus uva ursi*, and *Empetrum nigrum*, are rare in the Jura mountains, but plentiful in the bogs of Northern Europe. The principal genera, in addition to those already mentioned, are *Dicranium Meesia*, *Hypnum*, *Splachnum*, ferns, grasses, sedges (*Carex*, etc.), *Drosera*, and other bog plants.

Bogs generally occur in shallow depressions having a clay bottom or when the water rests on permeable matter, like sand; this overlies an impermeable subsoil. The water must be still, but not stagnant nor subject to the influence of rapid currents of water. Hence they generally originate in a lacustrine area, which gradually becomes filled up with silt and aquatic plants, and so becomes fitted for the vegetation characteristic of peat. As a consequence of this, bogs are most prevalent in lowland districts, but they may occur in mountainous country when drainage is impeded so as to form local accumulations of water.

Humidity is a very important regulator of the distribution of bogs. Wooded moors favour the growth of mosses, owing to the air there being moister and more shady than in the open country. Hence it is that the bogs of lacustrine areas in low-lying areas seldom have trees buried in them, whereas in mountain bogs trees are plentiful, the growth of the moss being favoured by the fallen trunk's damming back the water so as to form pools. This opinion is verified by the frequent occurrence of almost every description of tree, such as oak (represented by bog oak), birch, fir, ash, willow, yew, etc., which have been upset by the gradual advancement, and have been discovered in every conceivable position embedded in the bottom parts of the peat bog.

Temperature also is very important. That best suited for peat formation is a mean annual temperature ranging over a few degrees below and above 45° F. This coincides with the degree of latitude, for bogs are rare on the polar side of 45°, and peat gradually diminishes when the annual mean temperature is over 50°, or the latitude much higher than 50°. This generalisation will be borne out by an examination of the general distributions given at the end of this chapter, and noting the temperatures of the districts. One illustration may, however, be mentioned here. Peat formation has almost ceased in Scotland, but is still proceeding in Ireland. The latter country is moist enough, and has a favourable temperature; the former has a suitable temperature, but the humidity has gradually become too low, and as a consequence the peat is gradually wearing away, and natural forests have, for the most part, disappeared.

Peat is the result of the decay of plants, and the character of the peat depends upon the conditions prevailing during this decay and on the nature of the plants. If the air is dry, the temperature warm, and the vegetable matter rich in nitrogen, this matter is almost entirely volatilised and the residue is little more than ashes—that is, mineral salts. If, on the contrary, the matter is immersed in water, the temperature cool, and nitrogen rare or absent, the inorganic parts are left mixed with a carbonaceous material, the carbon proportion in which ranges from 1 up to 50 or 60 per cent., peat representing the higher extreme. The products vary with the supply of air. Thus with a free supply of air the residue is mainly humin; with less air it is ulmin; and when air is excluded it is gein. When oxidised these are converted first to ulmic, humic, and geic acids, and these in turn to crenic and apocrenic acids.

The essential condition of peat formation is that vegetable remains shall be laid down at a rate exceeding that of their decomposition. As a rule, the agents of decomposition keep abreast of the formation of dead organic matter. The chief agents of decomposition are anærobic bacteria, but moulds, yeasts, and the larger fungi also play a part. Physical and chemical agencies are also concerned. In general, the warmer the climate the less likelihood of the accumulation of peat; for although more vegetable remains are laid down in the warmer regions, yet there the general conditions of life are such as favour the healthy growth and rapid reproduction of those organisms which bring about organic decomposition. Hence peat, though not unknown, is rare in tropical and sub-tropical districts. In the colder countries, on the other hand, although, as a rule, plant-remains are laid down more slowly, yet peat frequently accumulates, because here the general life conditions are less favourable. Bacteria are found on the surface of the peat, but not, as a rule, in the lower layers. The process of peat formation once begun proceeds with accumulative rapidity, owing to the preservative properties of the peaty acids formed by the partial decomposition of dead vegetable matter. Could these antiseptic acids drain away, then bacteria would invade the lower layers, the accumulation of peat would be prevented, and the peat already formed would eventually disappear. When these acids cannot drain away, there accumulates that partially but not totally decomposed vegetable matter termed "peat." All conditions which are favourable to the growth and existence of those plants which live in and extend the area of stagnant places are factors in the formation of peat. In settled and civilised districts, stagnation on a large scale is not allowed to occur, and therefore it is only possible at the present time to witness peat formation on a small scale.

It may be said that the process which has operated to convert countless generations of plants into peat bogs has been similar in the case of coal to some extent, but geologically considered it is evident that the oldest peat deposits are of modern formation when compared with the most recent of the coal measures.

Peat was the name employed in Scotland and in the north of England up to the time of the eruption of the Solway Moss, in the year 1771, when it first appeared in the description of that accident, written by an English author. The English word for the substance, up to that time, was turf, which word was used for other substances besides, and therefore was very inappropriate and indefinite. Etymologists inform us that the word "peat" is probably a corruption of the Anglo-Saxon word "betan," which in combination with "fyr" signifies "to mend or repair a fire," "to light or make a fire," "to kindle a fire." In Devonshire, even at the present time, peat is called "beat."

Peat is soft and spongy at the surface, but becomes denser and more valuable with depth, owing to pressure and gradual advance of decay; hence the lowest and oldest part is the most carbonaceous.

Peat includes a great number of substances of very unequal value. The most recently formed spongy kind approaches wood in composition, whilst the dense peaty brown substance obtained from the bottom of the peat bog of ancient formation may be compared with lignite or even, in some instances, coal. Unlike wood, however, it contains incombustible matter in variable but large quantities, from 5 to 15 per cent., or even more. Much of this, when the amount is large, is often due to intermixed sand. When air-dried the proportion of water is from 8 to 20 per cent., but in its raw state it contains, under the most favourable circumstances, a very large amount of water varying from 75 to 85 per cent. of its total weight.

Peat mosses vary considerably in different localities, not only as regards appearance, but also in chemical composition. This difference arises from the climate, the kind of mosses and plants they contain, the amount of rainfall, the evaporation of the water, and the nature of the soil.

Roughly speaking, there are two kinds of peat, namely, "hill peat" and "bottom peat."

"Hill peat" is the one that is formed in mountainous districts, and is identified by the fact that the chief plants of which it is formed consist of *Sphagnum* and *Andromeda*, and several varieties of heath as well as pine trees. The impervious strata on the bottom of these peat bogs is clay, which is permanently covered with water. There is one peculiarity with these peat bogs, namely, that near the edges the peat is very shallow, but it increases in the middle to a very considerable thickness, varying up to 30 or even 40 feet.

"Bottom peat" is to be found near lakes, rivers, and brooks, and consists of a quite different vegetation, mostly *Hypnum*. This kind of peat bog has a horizontal surface, and is usually shallower than the hill bogs. The impervious strata forming the basin is a calcareous ooze. Bottom peat comprises three varieties.

The first is the *dark peat*, approaching to coal; it is usually cut from the lower part, and is heaviest. It shrinks most in the process of drying. This variety of peat burns slowly, and when fifteen sods are burned in a close stove they will leave about a large wineglass full of white ash.

The second is *light in colour* and weight, and is of newer formation.

The third is the *top stratum*, and is of least value except in those cases where it is suitable for the manufacture of moss litter, paper pulp, textile fabrics, etc. The last two varieties of peat leave more ash in burning.

In some places these differences in the quality of peat taken from the top or the bottom stratum do not occur, the moss being uniform throughout.

The mountain peat is generally the purest, the supply being free from sediment. That found in low lands, fed by streams or rivers, is the most varied in quality. The lowest and earliest formed peat is the densest, and frequently mixed with sand, mud, etc.

In Ireland the peat is classed into "lowland or red bogs" and "mountain or brown bogs."

The lowland peat is subdivided into clearing or growing surface; white turf, somewhat similar to the clearing, but of such consistence that it can be cut into parts; brown turf, a variety that can be manufactured into meal and inferior peat moss litter; black or stone turf, the best variety for the manufacture of fuel; black mud or buddagh, the bottom of the bog, which is of very little use for anything.

The mountain bogs are divided into clearing, brown turf, black or stone turf, and black mud.

There is nothing new about peat-burning. It has been used for generations as fuel, but it is impossible to say at what period peat was first used. That it was used, as it is at present, from a very early period of history there can be no doubt, and in the absence of lignites and mineral fuels, its great abundance, and the comparative ease with which it is obtained, its occurrence attracts attention to one of those sources of comfort and convenience which an infinitely wise Creator has laid up in the storehouse of Nature for the benefit of mankind.

Earl Eyner, of Orkney, when the wood ran short in the year 888, recommended the inhabitants to cut pieces of turf, dry them, and use them for fuel, which they did with so great a success that the practice soon spread to Scotland, Ireland, and to many parts of England.

Its value for the purpose of fuel was early understood in Germany, for Pliny says that "the Chaucé pressed together with their hands a kind of earth which they dried by the wind rather than by the sun, and which they used not only for cooking their food but also for warming their bodies."

Beckman, in his *History of Inventions,* mentions a letter of sanction by which the Abbot Ludolph in the year 1113 permitted a nunnery, near Utrecht, to dig "cess-pits" (Anglo-Saxon for turf) for its own use in a part of his *vena* (turf-bog). On the same authority we are told that the words *turba, turbo, turbae,* and *tufa,* occurred for *turf* in the years 1190, 1191, 1201, and 1210. The traffic of this kind of fuel is recognised in the *Leges Burgorum* of Scotland as early as about 1140. *Turbaria,* for turf manure, is found in the writings of Matthew Paris, who died in the year 1259. *Turbagium* is found in a diploma of Philip the Fair, in 1308, where its connection is such as to signify the right of digging turf. Brito, who lived about 1223, is quoted as mentioning turf amongst the productions of Flanders.

Growth of Peat.—The growth of peat varies considerably according to the nature of the plants and trees of which the peat has been formed.

In some bogs the growth appears to have totally stopped, whilst in others, especially on the hill sides, or in bogs which have been carefully worked, the vegetation is still vigorous on the upper surface.

The peat that has been produced by *Sphagnum* and other plants of the same class is most rapid in its growth.

Some of the bogs in Hanover have, from actual observation, been known to grow from 4 to 6 feet deep in thirty years. In other cases exhausted turf hollows have been again filled with new turf plants in from ten to twenty years, and have been formed into a useful turf in from fifty to a hundred years.

A wooden bridge made by Germanicus in his German War was found under a bog, and in Galway a hut and paved passage was found under 30 feet of turf.

The growth of peat mosses, in some places, must be cultivated. The peat in many districts, especially in Ireland, where the cultivation of peat has been neglected, is gradually becoming scarce and worked out, or, as it is called in Scotland, "worn out." This is especially the case where the country people have been and still are allowed to dig or cut the peat at their own free will without any restriction or supervision by a person in authority. From these causes we find in many bogs that the peat has been worked at irregular depths, so that the remaining good peat cannot be obtained although plenty is still left on the bottom of the bog.

Distribution of Peat.—Peat is to be found in all cold and temperate climes, in fact in any part of the world where water is still and the atmosphere moist and the temperature moderate; but where the decay of the plants is great and quick, the formation of any body of the substance and structure of peat is prevented.

It is seldom discovered within the tropics, or in the valleys, even in the south of France and Spain. The late Mr Charles Darwin stated that it is never found nearer the equator than 45 degrees latitude. No real peat or *Sphagnum* peat has yet been found in South America.

It is difficult to give any really accurate data with regard to the sizes and breadth of peat bogs, but we here append some particulars which have been culled from the best and most reliable sources.

Great Britain and Ireland.—The total area of bog land in Great Britain and Ireland is stated to be about 6,000,000 acres. In Great Britain alone there are about 3,500,000 acres.

Synfin Moor, or Syn Fen, on the north side of Swarkestone, in Derbyshire, covers an area of approximately 1400 acres.

The surface soil of about three-quarters of the South Lincolnshire fen land consists of alluvial deposit, the remaining 85,248 acres being peat.

In Huntingdonshire there is about 60,000 acres of bog land, in Norfolk 63,000, and in Suffolk 30,000 acres.

Black Mere Bog, in Cheshire, is about 1100 yards long and 650 yards broad.

Chat Moss Bog, in Lancashire, has an area of about ten square miles. It was in 1793–1800 the scene of the first great and successful effort for the reclaiming of bogs, largely through the means of Roscoe the historian, and in 1829 of one of George Stephenson's great engineering triumphs in the construction of the Liverpool and Manchester Railway. It is very slightly elevated above the sea, and from 20 to 30 feet in depth.

At Fleetwood, near Liverpool, there are two mosses separated by the river Ribble which contain separate peat and forest beds, varying from 2 to 20 feet deep. The upper peat is 12 feet deep and the lower peat from 2 inches to 10 feet deep.

At Huntworth, near Bridgwater, peat appears at two levels. It is of good thickness and contains shells, bones of horses and deer, and wood.

At Holderness, near Hull, there is peat with trees, 2 feet deep, and at Hornsea, near Hull, beds are seen at low tide which contain peat and black root beds 6 feet deep.

The deposits of the Thames Valley include peat and marshy clay.

Prescot Moss, in Lancashire, is 18 feet deep. Egton Moss Moor, in Yorkshire, is 20 feet deep.

Moss Flanders, in Perthshire, Scotland, reaching from the Bridge of Gartmore to the Bridge of Drip, has been computed to contain 10,000 acres. The Black Moss contains about 800,000 cubic yards of peat. Ordee Moss is about 60 acres, but it has only a depth of about 15 inches.

Logie Moss is about 20 acres in extent. Milton Moss is very large and about 20 feet deep.

The Solway Moss, on the western border of England and Scotland, is about seven miles in circumference. These bogs vary considerably in depth.

The vast peat bogs in Ireland amount to about 2,830,000 acres, and have an average depth of 19 feet 3 inches, some being from 30 to 40 feet in depth. The Moss of Shannon is said to be fifty miles long by two or three miles broad.

The immense bog known by the name of the Bog of Allen, or rather a series of bogs, stretches from the borders of the county of Dublin across the County Kildare and the King's County as far as the Shannon, and westward into the counties of Galway and Roscommon, spreading laterally through the counties of Meath and West Meath to the north of Queen's County and the county of Tipperary to the south. It has been computed that it formerly contained 1,000,000 acres, but by means of cultivation and drainage it is now diminished to 300,000 acres.

Crockglass, in the county of Donegal, is 6 feet deep, and

Bloody Foreland, also in Donegal, is from 8 to 10 feet deep. In Knocklaid, in the county of Antrim, the thickness of bog is nearly 12 feet.

Canada.—In Canada peat is abundant on the Carboniferous, Cambro-silurian, and granitic areas, usually occupying the depressions, which were formerly shallow lake basins of small extent, but sometimes covering tracks on the flat surfaces of the Carboniferous formation comprising many square miles. Deposits occur at Lincoln (Sunbury county), Orinoco and Magaguadire Lake, also north of Eel River lakes.

In the parish of Douglas and Bright (York county), especially about the head water of the Keswick and Nackelvicac rivers, there are beds of considerable area.

In Quebec there are large areas of excellent peat in several places. The largest and most easily accessible deposits are those on the line of the Canadian Pacific Railway between St John's and Farnham, and in the vicinity of the St Lawrence near Valley Field and Beauharnois, as well as in Huntingdon.

At Huntingdon, about forty-seven miles from Montreal, there is a peat bog of superior quality covering an area of about 800 acres, averaging in depth from 10 to 18 feet.

In the counties of Perth, Welland, and Essex, in Ontario, there are said by the best authorities to be 100,000 acres of undeveloped peat bog, the largest area being in the county of Perth, about eight miles north of the city of Stratford on the Grand Trunk Railway, which extends from Port Dover to Owen Sound, where the bog covers an area of 40,000 acres, having a depth varying from 1 to 20 feet.

At Mer Blue, in the township of Gloucester, in Ontario, there are two long peat bogs separated by a narrow long reach of higher land occupying each about 2500 acres, the peat being from 8 to 21 feet deep.

In Nepean and Goulbourn are three peat bogs varying from 100 to 300 acres each. In Huntley there are about 2500 acres of peat, which in some places varies in thickness from 8 to 10 feet, whilst in other parts no bottom has been found at a depth of 15 feet.

On the lower St Lawrence peat bogs are found at the River Ouelle, Isle Verte, Daquan, Matanne, Macnider, and other places, whilst on the island of Anticosti an immense bog, estimated at nearly 200 square miles in extent, occurs on the south-west coast, all of which are reported as being of very excellent quality. These peat deposits have a depth varying from 3 to 10 feet.

At the Morse river, also situated at Anticosti, there is a continuous plain covered with peat which extends for upwards of eighty miles with an average breadth of two miles, thus giving a superficial area of 160 square miles.

The well-known Holland Marsh along the Holland river, in the counties of Simcoe and York, contains about 20,000 acres.

In New Brunswick and Prince Edward Island are a great number of peat bogs. The principal bogs are at the mouth of the Kouchibouguac river, the estuary of Aldouane, and Richibucto Head. Along the Kent Northern Railway, from one to five miles above Kingston, there are two bogs. There are also peat bogs at the head of the Missaquash river on the isthmus of Chignecto.

In the Prince Edward Islands there are large bogs along the shores of Richmond and Cascumpec. Squirrel Creek bog covers an area of not less than 500 to 600 acres. At Black Bank, in Cascumpec Bay, there is a large peat bog which along the shore is 10 to 12 feet deep in places. At the mouth of the north-west angle of Drift Wood bend there is a distinct bed, about one foot thick, of imperfect lignite or indurated peat.

Denmark.—In Denmark the peat bogs extend over ninety square miles, or about 4 per cent. of the entire area of the country. The depth of the peat deposits varies from 20 to 30 feet.

France.—The great marsh of Montaire, near the mouth of the Loire, is said to be more than fifty leagues in circumference.

Germany.—The peat bogs in Germany are about 6 feet deep. The mosses at the Ems Valley, which cover an area of 1000 square miles, might furnish the equivalent of 300,000,000 tons of pit coal.

At Carolinenhurst there are about 6½ acres, 58 inches deep, which are cut each season and yield about 3000 tons of moss litter. It is stated upon official authority that a portion of the peat beds of this empire covers an area of nearly 4,942,000 acres.

Hanover.—In Hanover there are from 120 to 130 square miles of peat bogs.

Holland.—In Holland the peat bogs are about 6 feet deep. Near Amsterdam there are about 860 acres of bog.

Hungary.—In Hungary the peat bogs are very shallow, being as a rule not more than from 6 to 8 feet deep, and only one, the Marcazal Marsh, near Hegyes, attains a thickness of 16 feet.

Italy.—It is estimated that the Lombard Provinces, in Italy, contain 1005 hectares (2512 acres) of peat deposit calculated to be capable of yielding forty million quintals (179½ tons) of dried peat. The deepest mosses are those on the Lago d'Iseo.

Oldenburg.—Oldenburg has about twenty square miles of peat bogs.

Russia.—In the Russian Empire there are no less than 135,000,000 dessjatines of peat moor—that is, about 67,000 square miles. The peat bogs on the Crown lands in the provinces of St Petersburg, Moscow, Orel, Riazan, Vladimir, Tambov, and along the Kursk-Kieff line, are supposed to contain 100,000,000 cubic feet of excellent peat.

Southern Bavaria.—This country has an area of peat bogs covering about twenty square miles.

Sweden.—The Swedish bogs have been computed to hold peat in such quantity as to be equal to 3000 million tons of coal. Herr H. Steinmetz, engineer of the Department of Agriculture of Sweden, says:—"In Sweden there are peat bogs covering an area of something like 8,648,000 acres, varying from 24 to 30 feet in depth.".

United States.—Immense areas of peat are to be found in the United States, varying in thickness from 20 to 80 feet.

The Great Dismal Swamp of Virginia covers nearly 1000 square miles, having a depth of 15 feet of pure vegetable matter.

CHAPTER II.

SPECIFIC GRAVITY AND ANALYSES OF PEAT.

Specific Gravity.—The specific gravity of peat given by experimenters and analysts is not very reliable, inasmuch as they do not express very plainly, and in most cases not at all, whether it is the apparent or real specific gravity that they give.

TABLE I.

Description of Peat.	Specific Gravity.	Analyst.
Hanoverian light-coloured young peat, nearly unchanged	0·113 to 0·263	Karmarsch.
,, young brownish - black peat, on earthy matrix intersected by roots	0·240 to 0·600	,,
,, old earthy peat, without any fibrous texture	0·564 to 0·902	,,
,, old or pitch peat	0·639 to 1·039	,,
Irish peat	0·235 to 1·058	Kane, Sullivan.
,, average of many samples	0·600	,, ,,
,, Phillipstown	0·405 to 0·669	Sullivan, Gage.
,, Wood of Allen	0·335 to 0·672	,, ,,
Devon peat	0·850	Vaux.
Island of Lewis	1·130	Paul.

Professor S. W. Johnson, in his book *Peat: its Use as a Fertiliser and Fuel*, very clearly explains the difference between the apparent and real specific gravity, when he states:—"The apparent specific gravity means the weight of the mass—the air-filled cavities and pores included—as compared with an equal bulk of water. The real specific gravity of the peat itself is always greater than that of water, and all kinds of peat will sink in water when they soak long enough, or are otherwise treated, so that the air is removed."

Chemical Composition.—The valuable portion of a fuel is its carbon content. In this respect peat is somewhat inferior to coal. It has, however, many advantages over coal and other fuels, which will be clearly set forth in Tables II. and III. (on pp. 20–22), showing the composition of peat, and in the analyses of the different classes of fuel given in Chapter V.

As the authorities have expressed their analytical results in various ways, we have been compelled to make a number of special tables. Some authorities neglect nitrogen, others take oxygen and nitrogen together, whilst yet others give their analyses in combustible matter, volatile matter, water and ash.

Peat, sometimes called bog-earth or heath-mould, is understood by gardeners to be a sharp, sandy soil mixed with the dead, fibrous roots of heath, etc., and is usually of a dark-grey colour, such as is found upon the surface beneath the heath on dry commons, like Bagshot, Wimbledon, etc. This kind of earth is largely used in horticulture for the growing of heaths and plants of a similar nature, requiring a well-drained peaty soil indoors, also for all American plants outdoors, such as rhododendrons, andromedas, and azaleas, etc.

Another description of bog-earth which is found largely in such places as the New Forest, Hants, is of a rich brown colour, contains very little sand, and is one mass of dead, fibrous roots of bracken and other vegetable matter. It is used in the cultivation of orchids, ferns, etc., and many other

TABLE II.—ANALYSES OF PEAT.

	Description of Peat.	Water in Original Samples. Per cent.	Volatile Combus-tibles. Per cent.	Fixed Carbon. Per cent.	Ash. Per cent.	Authority.
1	Welland. From top to 20 in. depth. Calculated on 15% water contents	82·20	59·27	21·66	4·07	Report of the Bureau of Mines, 1903, Toronto.
	,, 20 in. to clay bottom at 42 in. ,, ,, ,,	87·48	56·78	21·05	7·17	
2	Beaverton. From top to 7 in. depth ,, ,, ,,	62·98	57·13	11·67	16·20	
	,, ,, 7 to 15 in. ,, ,, ,, ,,	83·31	67·58	10·39	7·03	
	,, ,, 15 to 26 in. ,, ,, ,, ,,	84·86	73·60	4·72	6·68	
	,, ,, 26 to 40 in. bottom ,, ,, ,,	82·98	56·93	·40	27·67	
3	Perth. Top. 5 ft. ,, ,, ,,	..	54·72	19·85	10·43	
	,, ,, 4 ft. ,, ,, ,,	..	57·81	18·92	8·27	
4	Brunner. Top, 3 ft. ,, ,, ,,	..	60·10	15·70	9·20	
5	Brockville. Upper stratum, 3 ft. ,, ,, ,,	..	55·08	20·62	9·30	
	,, Part lower stratum, from 3 ft. down to 5 ft. Calculated on 15% water contents	..	57·15	13·73	14·12	
6	Rondeau. Lower stratum beneath surface growth. Calculated on 15% water contents	..	58·56	23·29	3·15	
	Rondeau. Lower stratum beneath surface growth	..	54·60	22·44	7·96	
	,, From stock pile	..	67·99	11·06	5·95	
7	Newington. Sample No. 1. Calculated on 15% water contents	87·94	56·74	27·21	1·05	
	,, ,, ,, 2. ,, ,, ,,	86·66	54·42	28·61	1·97	
	,, ,, ,, 3. ,, ,, ,,	87·62	58·70	24·73	1·57	
	,, ,, ,, 4. ,, ,, ,,	90·12	58·15	25·30	1·55	
8	Great Dismal Swamp. Calculated on 20% water contents :—					
	Surface peat	20·00	50·05	24·97	4·98	S. W. Johnson.
	At 4 ft. depth	20·00	52·59	25·44	1·97	,,
9	Driftwood bend. Hygroscopic water 7·74%	..	23·13	22·05	47·08	C. Hoffmann.
10	Peat, Aikman's compressed ,, ,, 3·84%	..	41·22	48·04	6·90	Brown.
11	,, Dickson's ,, ,, ,, 8·55%	..	56·34	31·04	4·07	W. H. Ellis.
12	,, Prince Edward Island air-dried. Hygroscopic water 14·28%	..	60·10	21·80	3·28	Dr Harrington.
13	,, ,, ,, ,, ,, ,, 15·10%	..	59·10	22·60	3·20	,,
14	,, Hodge's process. Hygroscopic water 16·80%	..	49·80	26·90	6·50	,,
15	,, ,, ,, ,, ,, 17·32%	..	51·65	25·00	6·03	,,
16	Königsbrown, Würtemberg, kiln-dried	..	70·60	24·40	5·00	Berthiér.
17	Airgliana, Italy. Light peat. Dried by 100° of heat	44·19	36·44	16·44	2·93	Toso.
18	,, ,, middle layer ,, ,,	38·10	36·09	20·89	4·92	,,
19	,, ,, lower ,, ,, ,,	32·41	36·23	21·22	10·14	,,
20	,, ,, artificially compressed. Dried by 100° of heat	26·89	38·38	22·41	12·32	,,
21	Bog of Allen	..	37·53	61·04	1·83	Sullivan.
22	Maine, U.S.A.	..	72·00	21·00	7·00	Ellis.
23	Commander Islands, in the Behring Sea	..	39·53	60·48	3·30	Hoffmann.

TABLE III.—ANALYSES OF PEAT.

Description.	Water Absorbed.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Authority.
Peat dried at 212° F. .	..	66·55	10·39	18·59	2·76	1·70	Fickenscher, Germany.
,, ,, .	..	57·03	5·63	29·67	2·09	5·58	Regnault, France.
,, ,, .	..	58·09	5·93	31·37	..	4·61	,,
,, ,, .	..	57·79	6·11	30·77	..	5·33	,,
,, ,, .	..	57·16	5·65	33·39	..	3·80	Mulder, Holland.
,, ,, .	..	59·96	5·52	33·71	..	0·91	,,
,, ,, .	..	50·85	4·64	30·25	..	14·25	,,
,, ,, .	..	59·00	5·53	19·50	1.50	14·50	Johnston, Scotland.
Average peat . .	21·9	42·7	4·0	27·4	1·6	2·4	Tylvad.
Peat dried at 220° F. .	..	57·0	5·5	31·0	1·5	5·0	Dr Machattis.
Surface peat, Phillipstown, dried at 220° F.	..	58·694	6·971	32·883	1·4514	..	Kane and Sullivan.
Dense peat, Phillipstown, dried at 220° F.	..	60·476	6·097	32·546	0·8806	..	,,
Light surface peat, Wood of Allen, dried at 220° F.	..	59·920	6·614	32·207	1·2558	..	,,
Dense peat, Wood of Allen, dried at 220° F.	..	61·022	5·771	32·400	0·8070	..	,,
Surface peat, Twicknevin, dried at 220° F.	..	60·102	6·723	31·288	1·8866	..	,,
Light surface peat, Shannon, dried at 220° F.	..	60·018	5·875	33·152	0·9545	..	,,
Dense peat, Shannon, dried at 220° F.	..	61·247	5·616	31·446	1·6904	..	,,
Kilbeggan, Westmeath .	..	61·040	6·670	30·47	..	..	Kane.
Kilbuha, Clare . .	..	56·630	6·330	34·48	..	..	,,
Cappoge, Kildare . .	..	51·05	6·850	39·55	..	..	,,
Ockta, in Eastern Russia	..	39·084	3·788	51·088	..	..	Waskresensky.
Peat, 4·5 feet from surface, Tuam, Ireland	..	57·207	5·655	28·949	3·067	..	Ronalds.
Peat, 3·5 feet from surface, Tuam, Ireland	..	58·306	5·821	29·669	2·509	..	,,
Peat, 2·5 feet from surface, Tuam, Ireland	..	59·552	5·502	28·414	1·715	..	,,
Good air-dried peat, Galway	24·2	45·3	4·6	24·1	..	1·8	Dr Cameron.
Poor air-dried peat, Galway	29·4	42·1	3·1	21·0	..	4·4	,,
Dense peat, Galway .	29·3	42·0	5·1	17·5	1·7	3·8	,,
Air-dried peat, Devon .	25·56	54·02	5·21	28·17	2·30	9·73	Vaux.
Island of Lews . .	23·20	60·00	6·90	30·00	1·30	1·90	Paul.
Bresles	2·17	46·80	5·65	41·15	..	6·40	Marsilly.
,, ...	3·14	47·48	7·16	36·03	..	9·00	,,
Thesy	3·07	50·67	5·76	36·95	1·92	6·70	,,
,, ...	7·20	43·65	5·79	36·66	..	14·00	,,
Bourdon . . .	5·55	47·69	6·01	39·30	..	7·00	,,
Camon	5·59	46·11	5·99	35·97	2·63	9·40	,,
Riemencourt . . .	1·81	12·99	2·22	19·31	..	65·01	,,
Vulcaire	..	57·03	5·63	29·67	2·09	5·58	Regnault.
Lory	..	58·09	6·11	30·77	..	4·61	,,
Framont	..	57·79	6·11	30·77	..	5·33	,,
Friesland . . .	..	57·16	5·67	33·39	..	3·80	Mulder.
,, . . .	..	59·86	5·52	33·71	..	0·91	,,
Holland	..	50·85	4·65	30·25	..	14·25	,,
Ramstein . . .	16·70	62·15	6·29	27·30	1·66	2·70	Walz.

TABLE III.—*continued*.

Description.	Water Absorbed.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.	Authority.
Steinwenden	16·00	57·50	6·90	31·81	1·75	2·04	Walz.
Niedermoor	17·00	47·90	0·80	42·80	..	3·50	,,
Prussian	15·70	50·13	4·20	31·44	..	8·92	Baer.
,,	21·70	55·01	5·36	35·24	..	11·17	,,
Havel	17·63	56·43	5·32	38·35	..	9·86	Jackel.
,,	19·32	53·51	5·90	40·59	..	6·60	,,
,,	18·89	53·31	5·31	41·38	..	6·80	,,
Linum	31·34	59·43	5·26	35·31	..	11·99	,,
Hamburg	18·83	57·32	5·32	37·56	..	2·31	,,
Bremen	..	57·84	5·85	32·76	0·95	2·60	Breuninger.
,,	..	57·03	5·56	34·15	1·67	1·57	,,
Schopfloch	20·00	53·59	5·60	30·32	2·71	8·10	Nester and Petersen.
Sindefingen	18·00	45·44	5·28	26·21	1·46	21·60	,,
Irish peat, perfectly dry, average	..	59·0	6·0	30·0	1·25	4·0	P. Dawson.
Irish peat, including 25 per cent. moisture, average	25·0	44·0	4·5	22·5	1·0	3·0	,,
Irish peat, including 30 per cent. moisture, average	30·0	41·2	4·2	21·0	0·8	2·8	,,
Switzerland, air-dried, compressed, average	23·17	40·09	4·53	21·50	2·84	7·87	Goppelsroeder.
Peat, air-dried	21·9	42·7	4·0	27·4	1·6	2·4	Tyvald.

similar plants requiring a fibrous, peaty, but not very sandy, soil.

The mass of decomposed moss, etc., almost black in colour, which is dug out of wet fenny places, dried, and afterwards used for fuel, is of very little use for horticultural purposes.

Peat suitable for use in the cultivation of plants, with few exceptions, is thus constituted:—

TABLE IIIA.

Fine siliceous sand	156 parts
Unaltered vegetable fibre	2 ,,
Decomposing vegetable matter	110 ,,
Silica (flint)	102 ,,
Alumina (clay)	16 ,,
Oxide of iron	4 ,,
Soluble vegetable and saline matter	4 ,,
Muriate of lime	4 ,,
Loss	2 ,,
	400

CHAPTER III.

METHODS OF DIGGING, CUTTING, AND DREDGING.

Method of Digging, etc.—The oldest known method of obtaining peat consisted in digging it out of the ground with an ordinary spade, forming it into round balls by kneading it with the hands, and stacking them in the open air to dry.

After that, the method was adopted of digging the peat, which is still practised, with a spade, and cutting it into rectangular shaped blocks in the form of bricks. The spade, called a "slane" in Ireland, consists of an ordinary spade blade (fig. 1), but provided with a wing, A, so that it cuts two sides of the sod at once and a man follows cutting it to a given thickness. Another form of "slane," as used in America, is illustrated in fig. 2. In some parts of Holland a "slane" as illustrated in fig. 3 is employed. In this case it has two wings, A and B, so that three sides of the sod are cut at once instead of two. After the cutting, each block is placed on the side of the bank to drain till it can be handled. The blocks are then taken away on wheelbarrows and stacked to dry in the open air. After remaining in that state for a few days, the stacks are turned so that the bottom sods come to the top. This operation is repeated over and over again according to the state of the weather, but under the most favourable circumstances six weeks is, as a rule, the shortest time, and then the peat contains, on an average, 20 per cent. of moisture. This class of peat is called "dug peat."

In Holland and several other places the peat gets so wet that it cannot be dug in the above way. In such cases the peat is dredged out by a kind of scoop consisting of a canvas bag strengthened at the top by strong rings fitted with teeth so as to drag the peat and fill the bag. The peat is emptied on the edge of the bog to drain, and left in that state till it commences to crack in drying, when it is beaten or trodden by men or women with boards attached to their shoes. When it has been trodden so that a man's foot will not make any impression on it, the peat is cut in the usual manner with a spade, stacked, and dried in the open air.

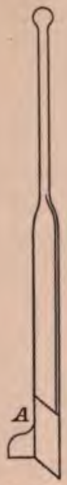

FIG. 1.—Irish Slane.

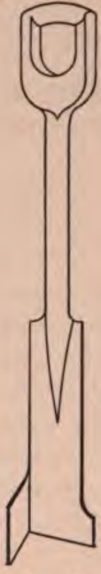

FIG. 2.—American Slane.

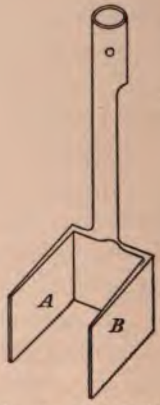

FIG. 3.—Dutch Slane.

The spade is of the shape shown in fig. 4, the blade of which is 8 inches wide by 10 inches deep; the handle is about 22 inches long, made of wood, and crutch-shaped.

In Mr Hodge's method, instead of cutting the sods in the above manner, the whole surface was cut transversely by means of curved knives six inches apart and mounted on a frame in the shape of a sledge as illustrated in fig. 5, which was drawn to and fro over the whole surface until it was scored with furrows. Two men, one on each side of the peat bed, were required for this operation. A few days after, or according to the state of the weather, it was cut in transverse lines with the former furrows. The instrument used in making this cutting was a sheet-iron disc, which was forced down through the thickness of the peat to the bed underneath. The blocks were cut in pieces 18 inches long.

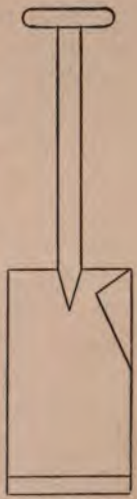

FIG. 4.—Dutch Spade.

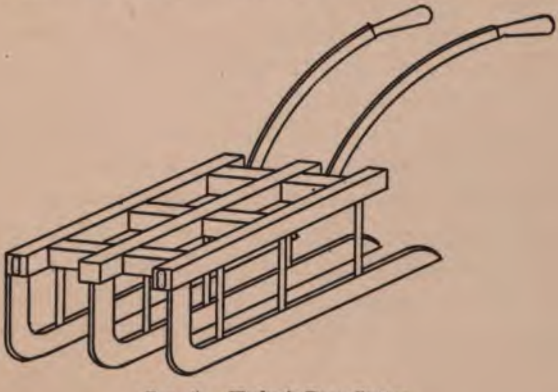

FIG. 5.—Hodge's Peat Cutter.

In some places the peat is taken out of the bog with an ordinary dredger and delivered into a hopper of a pug mill, in which it is macerated, parting with some of the water, and by means of a travelling belt is delivered on the banks of the bog, after which it has to pass through the same process as before described.

This kind of peat is called "dredged peat."

Another process for manufacturing peat fuel consists in preparing the peat after the two methods just described and afterwards consolidating the sods by passing them through a press, and in some cases the peat is compressed to such a degree that it compares favourably with coal as regards specific gravity.

This kind of peat is called "pressed peat."

Cut Peat or **Dug Peat.**—At the present time there are four methods adopted in working cut or dug peat, in Ireland, namely, horizontal cut or breast slane, downward cut or foot slane, Ballinrobe turf, and hand and foot turf.

Horizontally cut or *breast slane* is done by slicing the bog by means of flat wood slanes tipped with iron, the blade being about 2 feet long. The peats are 2 feet long, 6 or 7 inches wide and 6 or 7 inches thick, and when properly air-dried they have shrunk to from 12 to 15 inches long, 4 inches wide, and 3 inches thick.

Downward Cut or *Foot Slane.*—In this case the peats are cut short and thick with a flanged slane, in the lowland bogs; but in the mountain bogs they are longer, because the peat is tougher. They are cut from the brown peat 12 inches long by 6 inches square, and will shrink during drying to 8 inches long by 4 inches square. It is denser than the horizontally cut peat, on account of the men trampling on it during the process of cutting.

Ballinrobe turf is only met with in the county of Mayo. The peat is cut by two men, one at the breast and one above, so that it will be seen that this method of cutting is a combination of the horizontal and downward methods.

Hand Turf and *Foot Turf.*—These methods will be described under the head of "Dredge Peat," because they are only used for soft peat, or peat made into a pasty form by admixture of water.

As far as we can gather, the systematic reclamation of peat bogs was first commenced by the Netherlanders, and dates as far back as 1680. About that time it was determined that they should use their peat as a native fuel upon a most extensive scale. By means of canal communication, boats conveyed the fuel, not only to places in Holland, but even to neighbouring countries.

On the high level moors of Holland, the top layer of grey, and the lower one of black, soil vary considerably in thickness. On an average the grey is 3 feet thick and the black from 6 to 9 feet. The manner in which the peat or turf was manipulated in the grey layer consisted in cutting it with spades and other implements. The peats were placed in a saturated state, often containing 500 to 600 per-cent. of water, end on against each other in the open air to be dried, partly by the sun, but principally by the wind. When they became sufficiently hard to allow of their being handled, without breaking them, they were arranged horizontally in rows on and near each other to a height of about three feet, which process was termed *stacking in pyramids*. The object of this arrangement was to thoroughly dry the peat. After some time they were re-stacked in a similar way, the upper ones being placed at the bottom of the new stack, and the lower ones at the top. When perfectly dry, or at least as dry as they could be obtained by this means of drying, they were stacked in large heaps.

In the neighbourhood of Amsterdam, at that period, the manner of obtaining the fuel was considerably varied. After the removal of the top layer, *i.e.* the grey turf, in the form of bricks, it was dried in the air and sold in bricks, ranging in size from 12 to 20 inches long by 4 to 6 inches broad and 2 to 3 inches thick. The manner in which these peats were cut horizontally was as follows:—A plank was laid so far from the edge of the face of the peat as was required for the length of the block. The peat was then cut along the plank with a sharp spade by one labourer, whilst a second labourer cut the turf to the required thickness of 3 to 3½ inches, loaded it on a wheelbarrow, and brought it to the drying ground. When the work was completed on the staked-out ground, the plank was moved a length further back, and the operation of cutting repeated.

When the turf was cut perpendicularly, the peat cutter worked at the edge of the peat-face downwards with a sharp-edge spade, or slane, with rectangular corners, the dimensions of which were the same as those of the required peat blocks. These were often cut away on the lower edge with the so-called cutting iron, and were placed on wheelbarrows, taken to the drying ground, and treated similarly to the previous case.

In the common way of digging, one man can dig and lift 10 tons a day to a height of 5 feet. If a greater depth has to be worked, an additional hand has to be employed, but the quantity raised is the same, the first man casting a height of 5 feet, and the second raising it the second 5 feet.

In one of the methods adopted in gathering peat in the various parts of Germany, and permanently at the important peat bogs under State management, the turf is cut by gangs of four men. One cuts it from the top with a square-ended spade, the second man commences from the side following the first man, and at the same time dividing the turf into lengths as he cuts it. This latter operation is generally performed with a round-ended spade, but sometimes, though rarely, a three-sided square-ended spade is used. The third man follows the second, digs the sods out with a four-pronged fork, the handle of which is bent upwards to an angle of 45°, and lays them in rows on the moor behind the cutting. The fourth man wheels away the cut blocks.

About thirty years ago an attempt was made to get the peat out of the bog quickly and cheaply. A canal was made all round the peat bog, and in this two boats were placed each fitted with an engine, one being placed on each side of the bog. Between these two engines travelled a plough of the balanced type, but built on a sledge instead of on wheels. In the centre were placed circular discs cutting lines across the bog, and the mould boards of the plough up-ended the strips of peat, which were afterwards cut into short pieces by hand.

The great objection to drying the peat in the open air is the uncertainty of climate, since if exposed to the rain, as frequently is the case, a sufficient quantity of peat to supply the market cannot be dried during the summer months. Many attempts have been made for overcoming this, and amongst others the building of extensive sheds under which the wet peats are placed to dry; but there is one objection to this, namely, that the peats being close together, very little of the wind will act on those in the centre, and hence the time of drying is prolonged.

At the London Peat Works, situated at Little Eggleshope, Middleton, Teesdale, the drying arrangements, designed by Mr C. E. Hall and Mr C. E. Bainbridge, consisted of six sheds each 15 feet span of roof, making a total width of 100 feet open side, inclusive of covered space. These sheds were 200 feet long, covering an area of 20,000 square feet, and were fitted with racks placed back to back, leaving a pathway between. There were twenty racks six tiers high holding 672 trays each, or a total of 13,440 trays; a tray weighing

56 lbs. and one of dry peat 14 lbs., giving an evaporation of 75 per cent., whilst the remaining fuel held 20 per cent. of moisture.

The cutting of the peat in the Highlands of Scotland is usually different from the method adopted in cutting peat bogs. The first process is to cut open trenches each about ten yards apart from one another, and, according to the nature of the ground, from 50 to 400 or even 500 yards long, after removing the surface sods at the positions where the peat is cut for a width of about 3 feet along the whole line of the trenches. The peat cutter digs it out with a peculiar shaped tool in slices about 12 inches square and 3 or 4 inches thick. As quickly as the slices are cut a labourer takes them off the peat iron and throws them on to the surface of the bog to drain off the water. In this manner prisms of peat 3 feet in width and depth are cut out at intervals of ten yards, and the number of slices cut out of each trench are as many as the man can throw on both sides of the trench without altering his position, except along the trench as the cutting advances. One advantage of this method of gathering the peat is that it is not necessary to move the peat in barrows to the spreading-ground, which is attended with very considerable expense and labour.

Another method of drying is to stack the peat on trays made of wood attached to a pole about 7 feet high. In drying turf, four poles are placed in a rectangular form covered with a roof. Between these poles are five drying hurdles, one over the other, each carrying twenty bricks, and the turfs remain on these until sufficiently dry to be piled up in heaps.

Digging the peat appears very simple, and is so under ordinary circumstances, but the water frequently interferes with the process unless the bog is well drained. When the digging has been proceeded with to a depth of 4 to 5 feet, the sides often have a tendency to cave in, and, of course, the greater the depth the greater becomes the danger. When this is the case the best plan is to sink shallow pits and pump the water out as the digging proceeds.

The peat is sometimes cut by machinery. In North Prussia, Brosowsky's machine has been extensively employed, and upwards of thirteen hundred were made for Mecklenburg and Pomerania during the first five years of its introduction. This apparatus consists of a frame sharpened round the bottom edges, which, by its weight and by means of a crank and rack, and rack work operated by men, is forced down into the peat to any depth up to 20 feet, or according to the length of the rack. This machine can only cut at the edge of a ditch or excavation, and when it has penetrated to the required depth a spade-shaped knife is driven in under the cutter by means of a lever, loosening a mass of peat 10 to 20 feet long and a cross-section of about 24 inches by 28 inches. This column of peat is lifted by reversing the action of the crank handle, and is, when brought to the surface, cut by a spade into blocks 14 inches long by 6 inches wide by 5 inches thick. Each mass of peat cut to a depth of 10 feet makes 144 sods, and can be cut in about ten minutes. Four men can cut and lay out to dry 12,000 to 14,000 peat sods per day, or 3100 cubic feet.

The mode of operation of this machine is as follows:—It moves in a frame attached to a prolongation of the tramway in such a manner that six or seven pillars of turf, the length of which corresponds with the depth of the stroke of the machine, can be cut. It is worked by means of a cog-wheel. The pillars of turf thus separated are cut off at their base by pulling down an arm of a lever. A plank on the tram is brought into a vertical position. The whole pillar is then raised by turning the hand wheel so that it is pushed along the plank. The cutter is then turned, together with the plank and pillar of turf, and held in its place by suitable bars. Letting the top end of the plank down, the pillar of turf remains laying on it and is carried on a tram over the tram line to the drying place, where it is cut into bricks. The cutter is then again brought into a vertical position and pushed on one division further, and the process repeated. It will be noticed that only one labourer is required for holding up the turf and placing it on the tram. A second man cuts the turf into bricks and piles them for drying. This machine is generally constructed for a depth of 4 to 6 feet if for Holland; but the makers also construct them for all depths, even up to 40 feet. The principal advantage of this apparatus is that it can be employed to raise peat from a bog below water-level without the necessity of draining.

Mons. Lepreux, of Paris, made many improvements in the Brosowsky machine, by means of which two men can raise and cut 40,000 sods per day, which is equal to 5600 cubic feet.

Herr Karl Weitzmann's peat cutting machine is illustrated in side elevation, fig. 6, and front end view, fig. 7. The special feature or improvement in this machine over Brosowsky's is the feed and tilting motions. The rack E, slide and cutter C, can be brought into such a position that the greatest weight is nearest the guide D, and the slide has only one support, A, so that a heavy weight of great length can be easily raised. By tilting the frame, and consequently the cut and raised peat, the latter can easily be removed from the machine, without the plank necessary when the Brosowsky machine is used as previously described. Two steps, A, and tappets, F, secured to the tooth-rack guides permit the rack to turn on its centre into the horizontal position. The cutter is forced down into the peat, and raised out of it with the cut peat by hand wheel, spur wheel, and pinion.

Dolberg's Hand Peat-cutting Machine.—This machine consists of a three-sided underframe, the cutter attached to the toothed rack and pusher, and the windlass arrangement. The underframe is made of oak, and is provided with tram wheels which run on rails. The underframe is also furnished with a strong upright channel iron frame which carries the cutter and winding arrangements. The tooth rack consists of two rolled channels with the necessary stay bolts, which latter form the teeth of the rack. The upright frame also forms the guides for the cutter and rack. At the bottom

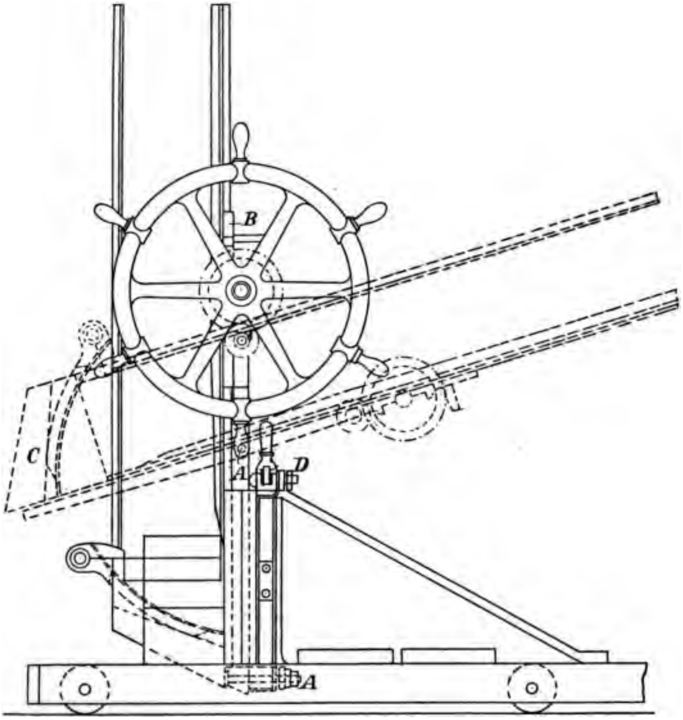

Fig. 6.—Karl Weitzmann's Peat-cutting Machine—Side Elevation.

end of the toothed rack is arranged a curved hoe-shaped knife which can easily enter the peat. This cutting knife is operated by the working gear, whereby the resistance of the peat cutter is reduced and the peat can be cut with ease to the depth of 6 feet 6 inches. The gear can be worked by one man at the handle.

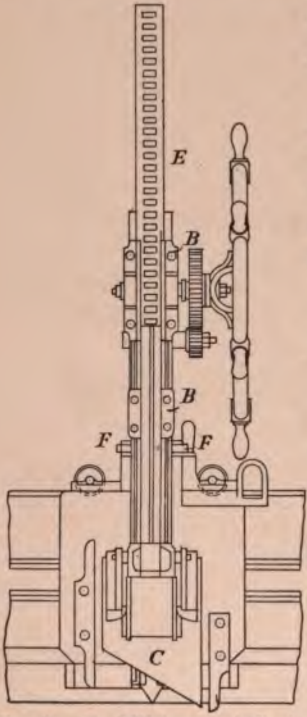

FIG. 7.—Karl Weitzmann's Peat-cutting Machine—Front-end View.

Dolberg's Small Peat-cutting Machine.—This is worked direct by being pressed down by hand, and the mass of peat is cut off at the base by means of a disc rotated by a handle at the top.

Peat trucks or *cars* are used for removing the cut peat turfs, or peats, from the bogs, usually on light tramways.

They are made of various materials, such as wood, iron, or steel. They consist of two or more shelves on which the peat sods are laid. The one illustrated in fig. 8 is made of iron with wood cross-bars.

Dredge Peat.—This kind of peat is sometimes called mud peat. It is the peat which is so saturated with water and so incoherent that it cannot be cut. To obtain this kind of peat it must be dredged from the bottom of the bog, and this is effected by means of a massive iron ring to which is secured a bag made of strong sacking, the whole being attached to a long handle and dragged along the slope of the bog. When full it is brought on to the land, emptied, and the peat left to drain and dry. In some cases an iron scoop, in the shape of a pail, is used, having its upper rim made sharp for cutting the peat, the pail being secured to a long handle. The bottom of the pail is formed of sacking. The peat mud is emptied on to a prepared ground, nicely levelled, and enclosed with boards 14 inches wide set on edge. The partially dried peat is emptied into this prepared place and left till it cracks on the surface. It is solidified by men with boards attached to their feet, who tread on it until the foot leaves no impression. Next, the peat mud is cut up in the manner already described, either by sledges or sharp spades.

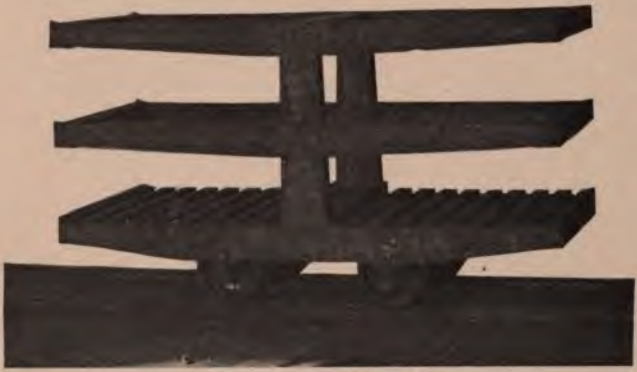

FIG. 8.—Peat Truck, or Car.

The method frequently, even at the present time, adopted by the Irish farmers for supplying themselves with peat fuel consists in, first, roughly levelling the drying-ground, and stripping the place where they intend to dig. When this is done, four men commence to throw the mud peat from the hole they have dug out, and two men break and mix it with a fork, continually trampling on it and turning it over. This mixing is necessary, as all the different qualities of peat are employed, to make an even and uniform fuel. When the mixing is completed, the mud is wheeled on hand-barrows to the drying-ground, where it is spread out to a thickness of from 9 to 12 inches; after which one man shapes the mud with his hands, cutting it into blocks or sods by drawing his hand across, at intervals of about 12 inches.

The cost of manufacturing turf by this process is approximately 10s. per ton, delivered, stacked, and covered over with thatch on the farm.

This method is mostly employed in the County Cavan, Ireland. The digging commences at the end of May or the beginning of June, and the harvest is completed in September or October, although when there has been a wet season, such as that of 1903, fuel made in June was still so wet on the bog in October as to be quite useless.

CHAPTER IV.

DRYING PEAT.

THE greatest problem encountered in the manufacture of peat fuel is the extraction of the moisture from the peat. Many methods have been tried, but none of them, up to the present time, have given perfect satisfaction.

There are three general principles that have been resorted to in all the methods that have been adopted, namely, air, pressure, and heat.

Air Drying.—This method is probably the best for small quantities and during a dry season. Sun is not necessary; the wind drying is the best because the strong heat from the sun dries the outside crust of the peats, and it takes a longer time to dry the interior of the blocks. The wind dries the blocks gradually, without hardening the surface, therefore the moisture from the interior has an easier access to the exterior.

A great amount of labour must naturally be expended in turning the peats over, especially in rainy seasons, and they must be placed in such a manner that the wind has a free access to them, so as to shorten the time of drying to a minimum.

Sheds have been employed for protecting the peats from rain during drying, but the expense was great, not only in the first cost, but also in placing the peats on the shelves; and the access to the wind being impeded, the time occupied in drying was prolonged.

Drying by Absorption.—This process was tried at Lexington, Mass., U.S.A. By this method the drying-ground was covered with a layer of porous bricks, on to which was spread pulped peat as it came from the macerating mill. The bricks absorbed part of the moisture on the underside, and at the same time evaporation was effected at the top by the wind. The process was naturally going on when the bricks were dry, but the bricks also absorbed the moisture from the ground they rested on, and the rain above would also fill the pores of the bricks with water, which prevented the expected result from being realised. Besides this, the expense of the drying-ground was enormous.

Drying Non-bituminous Turf.—One method, employed at Buchscheiden for non-bituminous peat containing 3 to 5 per cent. of ash, was as follows:—The turf was cut into bricks about 10 inches square and 3 inches thick, which were allowed to remain on the drying-ground for two or three days, in order to attain sufficient consistency. These peats or sods were next fixed on poles. The apparatus consisted of wooden poles 3 to 4 inches in diameter, on to which were secured eight or nine horizontal cross-bars 1 inch in diameter and 2 feet 6 inches long. The cross-bars were pointed at both ends. On each half of the bars were placed four or five sods of peat, the sods having a hole in the centre, made for that purpose, through the 10 by 10 inches surface, so as to make them hang parallel to the central poles, reducing the exposure to the rain. These poles and cross-bars were placed in rows about 5 feet apart. The drying by this method occupied about three to eight weeks, usually four to six weeks, and was repeated, at Buchscheiden, about five times in the year. Bituminous peat contracts about two-thirds of its volume in the process of drying, and the light non-bituminous peat one-third.

Exter Drying Process.—The peat is gathered in a fine or powdery state from the surface of the bog. The layers or slices break up at once before the peat is collected into heaps and partially dried upon the bog. It is then removed to a shed, provided with a roof but open at the sides, where the drying continues by evaporation.

The best air-dried peat still contains 12 to 15 per cent., and in many cases as much as 25 per cent., of moisture, although the sods feel perfectly dry to the touch.

Jacobson's Field Peat Press (*Frontispiece*).—This field peat press is quite a new implement, pressing the peat directly on the drying field. The peat is thoroughly mixed and disintegrated in the usual way, and comes from the mouthpiece into common dumping cars, which are driven round the field, by means of a rope line. From the cars the peats are dumped into the field press, which, by means of another rope is moved slowly forwards, thus spreading and pressing the peat against the surfaces of the field, leaving it behind, formed in smooth columns, which afterwards, by means of special knives, are divided into clots, each containing the mass of one peat.

This method saves much labour, in fact, six to eight men, and the bad and dirty work by handling the pallets and laying out the columns by hand is quite dispensed with. The peat also dries better, and becomes a more regular shape than by other methods.

Drying by Pressure and Centrifugal Force.—Drying by pressure has been tried, but has given very poor results. When the peat is exposed to pressure, a hard crust is formed on the surface, and the moisture in the interior cannot get away.

Centrifugal machines have been tried, and with great success so far as getting rid of the moisture is concerned, but the time taken for removing the peat after the drying is too great; hence this method is too expensive, and has therefore been discontinued.

Drying by Heat.—The apparatus employed for drying by heat may be divided into three classes, namely:—

First, drying in a chamber by means of heat radiated from stoves or by means of piping, which is termed "drying by radiation."

Second, drying by means of hot products of combustion, or "drying by smoke."

Third, drying by artificially heated air, or "hot air drying."

The most important point to be borne in mind when drying peat by heat is, the watery vapours evolved must be carried off, especially if a great quantity of hot gases pass through the oven and the temperature is kept uniform.

One of the most advantageous ovens for drying peat for fuel is probably the one employed at Lesjöfors, in Sweden. In this, the hot gases are conducted from the roof downwards, by means of an exhaust fan, thus producing a uniformly-dried peat.

The drying apparatus employed at Neuberg, in Styria, in about the year 1869, consisted of a drying chamber 36 feet long, 16 feet wide, and 13 feet 6 inches high, having an arched roof. On one side was provided a fireplace, and on the other a chimney 2 feet square and about 24 feet high. The fireplace and chimney were connected by two tubes 12 inches in diameter, placed 2 feet 3 inches from the bottom of the chamber. These pipes conveyed the hot gases into the chimney. Square openings were provided in the arched roof for removing vapours.

An example of the apparatus heated by the gases from a furnace is one which has been employed at Lesjöfors. The chamber for drying the peat was built of bricks made of blast furnace cinder, and well secured by irons. The oven bottom was made of iron lattice work, and constructed in the form of a roof. This bottom was fitted with a number of slides for the purpose of removing the dried peat. The waste gases from a refinery hearth were conducted into the chamber through flues below the roof, provided with a sliding door. The gases were first passed through a chamber where sparks were caught so as to prevent any danger of the peat being set on fire.

Dobson's Dryer.—This dryer consists of a sheet-iron cylinder or barrel, 3 feet in diameter by 30 feet in length, set at an incline of 14 inches in the length, fitted inside a rectangular brick chamber. A shaft enters the cylinder for a distance of 12 feet at each end, passes through the brickwork, and is carried in plummer blocks. The cylinder is furnished in the interior with six rings of 3 by 3-inch angle iron, secured horizontally, leaving a space of 3 inches from the plate to the angle iron. The cylinder is rotated by a sprocket wheel and a detachable link chain, at a speed of 1½ revolutions per minute, thus allowing the peat to remain in the furnace twenty minutes. The dryer is fitted with a suitable fireplace with necessary chimney. A funnel, or hopper, is provided through which the peat is fed into the cylinder. The peat is continually turned over and passed along by the angle irons and the inclination of the cylinder, and delivered, dried, through the funnel. The products of combustion from the fireplace pass along under the cylinder to the back end, and then return through the cylinder up the chimney.

A furnace of this description was tested for a day of ten hours at Beaverton Works, Canada, with the following results, given in the *Report of the Bureau of Mines*, Toronto, 1903:—"Weight of air-dried peat charged into the dryer, 29,300 lbs., containing 34·21 per cent. water; weight of peat discharged from dryer, 23,000 lbs., containing 16·61 per cent. water. The weight of water evaporated was 6300 lbs. Air-dried peat containing 34 per cent. water was used as fuel at the rate of 3145 lbs. per day."

Simpson's Peat Dryer.—This dryer consists of two parallel revolving cylinders placed one above the other. These cylinders are 30 feet long, made of ⅜-inch iron plates, and furnished in the interior with L-irons, as in the Dobson dryer, for lifting and stirring the peat during drying. The peat first passes through the lower cylinder, from whence it is discharged into the elevator and on to the conveyor, which transfers it to the front end. From thence it is elevated by chain and buckets into the top end of the cylinder. When it has passed through the latter cylinder it is discharged through a shoot. A fan is provided for exhausting the vapour arising from the drying, the vapour being led to it through apertures. The upper cylinder is rotated at a speed of three revolutions per minute and the lower cylinder nine revolutions in the same time, by sprocket wheels and link chain. The dryer is furnished with a suitable fireplace and chimney. The gases of combustion pass from the fireplace along and around the lower cylinder and second compartment, and next into the upper chamber containing the cylinder. From this it will be seen that this dryer belongs to the "Radiator" class.

CHAPTER V.

PEAT FUEL MANUFACTURE.

Manufactured Peat.—Peat that is not cut into brick-shape, but pulverised and afterwards formed into blocks of any shape and size, is termed *manufactured peat.*

Challeton's System.—It appears that the earliest attempts at making dense turf by mechanical arrangements were those of M. Challeton in France. In the year 1860 the first works of this system were erected at Mantanges, near Paris. The turf was cut from the bog and brought to the works. The raw peat was dumped into a hopper of a tearing machine consisting of cast-iron rollers 1 foot 6 inches in diameter and a length of about 4 feet, the surfaces of which were fitted with knives 4 inches in length. Whilst passing through the machine water was mixed with the peat, so that the peat came out of the machine in the form of a thin pulp. The pulp was elevated to the upper floor by a chain pump, where it was run over a fine sieve to free it from all coarse fibres and other foreign matter. The fine peat pulp was run into vats varying in size, the smallest being 40 feet square and from 12 inches to 2 feet deep, having their bottoms covered with coarse grass or rushes, which formed a porous bed and allowed the surplus water to drain off. In a short time the pulp became dry enough to be cut into blocks. The blocks were then dried either by artificial heat or by the air. The cost of production was about 13s. per ton.

Robert's System.—A plant according to this system was erected at Pekin, N.Y. The machinery consisted of a 13-horse-power semi-portable engine and a revolving elevator and conveyor. The elevator was 75 feet long from the top of the machine to the ground, where the peat was dug up and dumped into a revolving wheel, which separated the stones and coarse fibres from the peat and delivered them on one side, after which the peat was mixed with water and passed through the machine, where it was made into the consistency of a paste. The paste was discharged on to a conveyor about 100 feet long, which carried it that distance and then dropped it on the ground to a depth of 5 to 6 inches. When sufficient paste had covered the ground, the conveyor was turned round about 2 feet, and work commenced again till the fresh space was covered. This process was continued for the distance of two rods in length and 2 feet in width. This paste had to lie a week on the ground, when it was cut through with knives, at the expiration of which time it was turned over and allowed to lie another week, it usually taking three weeks before it could be removed. It was then taken up and put in a shed, and in about one week more it could be used, but the longer it was kept the better fuel it made. This machine turned out from 20 to 30 tons of peat per day.

Siemen's System.—This system was invented in the year 1857 by Professor Siemens of Hohenheim. It consisted in dumping the peat into vats made by boards of wood, in which it was soaked and worked with water, after which it was elevated into a pulveriser. This was performed in a machine of the same type as used for pulping potatoes and beets for sugar-making. This broke up and grated the peat to a fine pulp. After this process it was delivered into moulds, which were next emptied, and the peats carried away to the drying-ground, where they were air-dried in the usual manner. By this system 10,000 peat blocks were made by eight men in one day. Professor Siemens calculated that the peat fuel prepared by his system cost about one-third more than the ordinary cut peat, but the extra cost was recouped by the additional heating effect obtained.

This system was invented for peat mixed with shells and clay, which destroy the coherent property of peat, and the peat which had been exposed to the cold weather, from the ditches, that could not be worked in the ordinary manner.

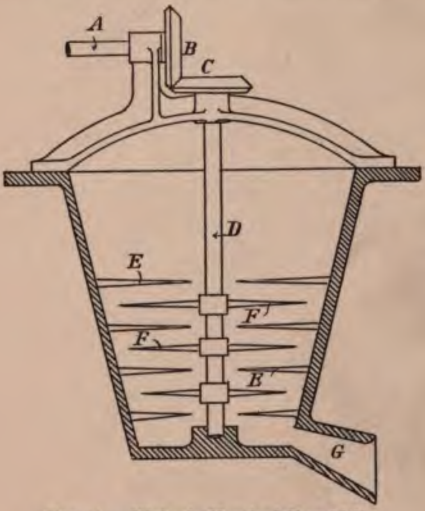

FIG. 9.—Weber's Vertical Pug Mill.

Weber's System.—This system consisted of a vertical pug mill, illustrated in fig. 9, in which rotated a vertical shaft D, fitted with cutting knives F, which revolved between other knives E, fixed in the interior of the cylinder of the mill, by which means the cutting up of the peat was performed. The peat was cut from the bog, cleaned of sticks and the thick roots. It was raised to the hopper of the pug mill by an elevator, and by the action of the knives it became cut and torn, and was delivered from the orifice G in the bottom in the form of a pulp. The cylinder was made of iron in the form of a cone 2 feet in diameter at the top and 1 foot 6 inches in diameter at the bottom, and 3 feet 6 inches high. After the pulp had been delivered it was moulded and dried, either in the open air or by artificial heat in a drying chamber.

One of these machines was at work at Staltach on very light peat, the moor being about 475 acres in extent, and varying in depth from 12 to 20 feet.

A good method for moulding, adopted by Professor Siemens, is illustrated in diagrammatic form in fig. 10. It consisted of a pair of rolls A and B. The roll B had a series of moulds on its periphery, which were provided with sliding bottoms. The peat was pushed into the moulds by two rolls C and D. On the roll A were projections E E, which corresponded with the moulds in roll B, and when the rolls revolved the projections E E compressed the peat. As each mould passed, the excentric G, acting upon the pin F, forced the movable bottom of the moulds outwards and discharged the peats upon an endless band, by means of which they were removed from the press.

Schlickeysen's System.—This system was intended to be an improvement on Weber's system. The machine consisted of a vertical cast-iron cylinder having a central revolving shaft fitted with knives for mixing and tearing the peat. The shape of these knives was such as to force the peat downwards during the time that they tear it. The peat was in this manner forced out through a moulding piece situated at the bottom of the cylinder. In this moulding piece there were three openings, each about 3½ inches square. As the stream of peat passed out of the mould they were cut in pieces about 10 inches long by hand. The peats were then placed on boards, and removed on barrows to the drying-ground or a shed provided for that purpose. The peats on

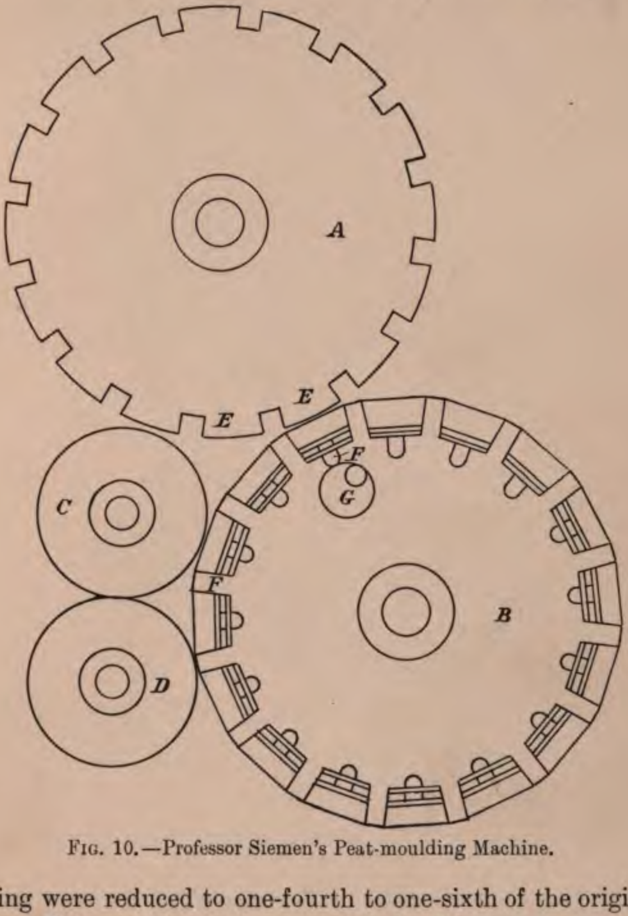

FIG. 10.—Professor Siemen's Peat-moulding Machine.

drying were reduced to one-fourth to one-sixth of the original bulk. This machine is illustrated in fig. 11.

Gysser's System.—This is a hand machine which can be worked on the bog, on the spot where the peat is cut, but is not suitable for peat containing heavy roots or that which is of a fibrous nature. This machine is shown in elevation, fig. 12, part sectional elevation, fig. 13, and plan of cylinder, fig. 14. A is a cast-iron conical cylinder, surmounted by a wrought-iron hopper B. On the revolving shaft G are six knives secured in a spiral form, some curved upwards, and others downwards. Another series of knives is secured to the cylinder. The shaft, when rotated by the bevel wheels L and M, is turned by the crank handle K. The fixed knives work between the knives on the revolving shaft, and move in the contrary direction. Beneath the knives on the shaft is a spiral iron scraper, which forces the peat out through the opening E at the bottom of the conical cylinder A. The opening is cylindrical, and has at its centre a cone F, held central by two sharp-edged ribs, so that the peat comes out in the form of a tube, which is

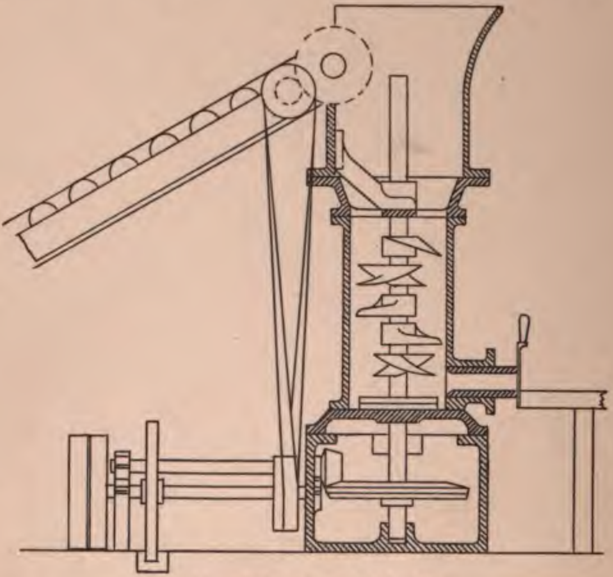

FIG. 11.—Schlickeysen's Machine.

broken off in lengths of about 14 inches. Two men and two boys can produce 2500 to 3000 pieces per day, which shrink in drying to 9½ to 10 inches in length and 2½ inches in diameter, and weigh about 1 lb. each.

Leavitt's System.—This machine is described by Mr T. H. Leavitt in his book *Facts about Peat*, from which we borrow part of the following description. The process is similar to the Weber's method, except there is no drying by heat employed. One of these machines, erected for the Boston Peat Company, consisted of a cistern 3 feet in diameter by 6 feet high, supported on a framework about 4 feet above the floor, at a place near the bog. The building was constructed on a hillside, so that an easy access was had to the lower storey on one side from the bottom of the hill, and to the

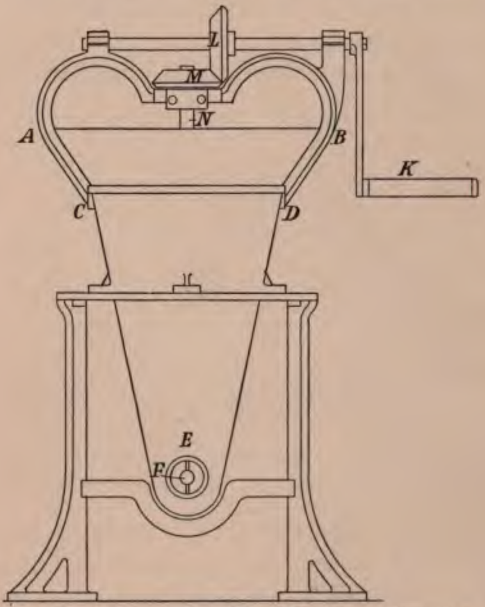

FIG. 12.—Gysser's Hand Peat Machine—Elevation.

second storey on the other side. The top of the cistern was open, and level with the floor of the second storey. Inside the cistern, and firmly fixed to the side, were numerous projections of forms adapted for the treatment of the material in its several stages as it progressed through the mill, which was divided into three compartments. Through the centre of the cistern revolved an upright shaft, to which were secured knives varying in form to correspond with the fixed ones in each compartment. Below the cistern was a hopper, and under this a moulding machine, 2 feet in width and 12 feet long, of a similar construction, which received the condensed material from the hopper, and delivered it in blocks of any form and size.

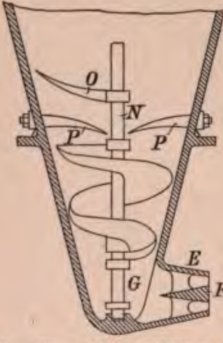

Fig. 13.—Gysser's Hand Peat Machine —Part Sectional Elevation.

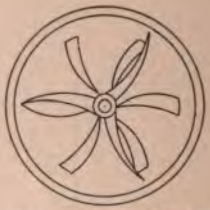

Fig. 14.—Gysser's Hand Peat Machine—Plan of Cylinder.

The crude peat was dumped into the mill. The treatment was such that the original form of the peat was entirely destroyed. In the second stage the air contained in the peat cells was ejected, and the mass was condensed in its moist state in the lower part of the mill, and was discharged in a continuous line of moulds, which were fed into the back of the machine at the rate of from 50 to 100 tons per day of ten hours, and the weight of dry hard peat produced per day was from 12 to 17, or 25 to 35 tons from the two sizes of machines respectively.

German System.—The following system was, and is even now, frequently used in Germany. The wet turf, as cut from the bog, is put into a breaking machine, which cuts and grinds it quite fine. The *mull*, as it is called, is dried by passing it through a cylinder carrying exhaust steam from the engine; the inside of this cylinder is fitted with large steam pipes and continually revolved, the cylinder being placed at an angle. From this cylinder the mull is passed into a hopper of a pressing machine. The press makes eighty briquettes per minute, or 35 tons per day.

Clayton's System.—This system consists in cutting peat into fragments in its raw and moist state, draining off all free water, masticating the fibres and the whole mass of peat together in a machine, until it is impossible to detect the fibres from the humus.

This machine consists of a cutting, kneading, and moulding machine, which is driven by a belt pulley through a double cone friction clutch, which latter drives a shaft on which is keyed a pinion, gearing into the spur wheel upon the shaft. On this shaft is keyed another pinion, gearing into a spur wheel keyed on to another shaft, which traverses the cutting up and kneading cylinder. The lumps of peat are thrown into a hopper, and first reduced in size to some extent by the action of blades ; but the cutting up and kneading is mainly effected by propelling arms forcing themselves through the peat and carrying it again and again between the knife blades, whilst it is firmly compacted between the feeding worm, which has a quick pitch, and the delivery worm, which has a comparatively slow pitch. It will be noticed that the knives are placed closer and closer together in passing from the feeding to the delivery end of the cylinder, and, to correspond, the propelling arms are widest at the feeding

end. All the propelling arms are flat on the face, and their spiral arrangement is such that they act effectively to keep the peat in motion rapidly forward through the machine.

This machine has five moulding orifices which are all formed in one die, bolted to the mouth of a chamber. Beneath the chamber is a roller table, on which boards or trays are placed to receive the moulded peat. The boards or trays of peats are conveyed along the roller table until they are opposite drying racks, when they are lifted off on to and placed on the latter, where they remain about three days. After that period of time the peats are placed upon open shelves for final drying. On an average it takes about three weeks before they are well dried and ready for use.

Gwynne's System.—This system consists in depriving the peat of a large percentage of water by means of a centrifugal, after which it is ground to powder, and passed through a series of cylinders revolving in a heated chamber, to evaporate the remaining part of the water. When the peat has been subjected to a temperature of about 180° F., it is compressed into blocks.

The peat to be manufactured into fuel is fed into the mill, where it is prepared. From thence it is passed by a chute into an elevator, from whence it is conveyed by elevator buckets to the top pair of a series of cylinders. These cylinders are driven by a pulley, and the rotary motion is transmitted throughout by a series of spur wheels keyed on to the ends of the cylinder shafts. A furnace gives the necessary heat to the cylinder for effecting the drying of the material. The interior of the cylinders, for the purpose of agitating, mixing, and propelling the peat under treatment, was fitted with ribs or screw blades. As the cylinders revolved, the peat travelled along them and fell from one to another until it arrived at chutes, through which it passed into a chamber thoroughly dried.

After this operation the dried peat was ground and passed into the compressing machine. The main driving shaft is carried in bearings on vertical frames, and has keyed on to it a driving pulley and fly-wheel. This shaft carries also two spur pinions, which give motion to spur wheels, keyed on to the ends of the shafts. A strong cast-iron standard bolted to beams carries the shafts in the bearings. Each of these shafts is fitted with an eccentric, which is connected with compressing plungers by tightening brasses. The moulding table is actuated by a spring catch, which consists of a lever, working loose on a tubular centre underneath the table. A spring catch fitted with a projecting pin is fixed to this lever by a screw. The pin projects through the lever into indirect grooves, formed in the raised portion of the table. One edge of the lever is inclined for the purpose of raising the end of a spring detent, which is secured at its extremity to the standard. This spring is fitted with a stud pin which is pressed into one of a series of holes formed in the table; by this means it is held steady during the compression of the peat, which is effected in the rectangular openings; the outer end of the lever is attached to a connecting rod, which is jointed at its opposite extremity to a vertical lever arm. This lever works on a fixed centre, and is guided by a forked or slotted guide, bolted to one of the beams. The necessary vibrating motion is transmitted to this lever by a connecting rod, which is attached at one end to the free extremity of the lower arm, and at the other end it is connected with a crank fitted on the end of a short shaft; a steam pipe communicates with the interior of the moulding table for the purpose of heating the same. To effect this the table is cast hollow, with a plate or cover bolted over it, the waste steam passing off by a pipe. The compressing plungers work in fixed guides, which are bolted to the frame; each carries a stud which passes through a lever, working on a fixed centre on the side of the lever frame. This lever is fitted at its end with a discharging plunger, which works vertically in guides also carried by the frame. A portion of the frame is made to project laterally beneath the table, so as to form a bottom to the compressing apertures which are under the feeding hoppers, thereby enabling the aperture to be filled with peat to be compressed, and retaining it in its chamber until it is brought under the compressing plunger.

The operation in working the compressing machine is as follows:—The peat is fed into the hoppers, and an intermittent rotating motion is communicated to the table by a lever and connecting rod; on moving the rod in one direction the knife edge of the lever is brought underneath the end of the fixed spring, thereby raising the stud pin out of the series of holes in the table. The same movement of the lever slides the pin up the inclined groove or slot, until it arrives at the commencement of the next hole, into which it passes by the spring. By this time the pin is completely free from its hole, and the return or back stroke of the lever propels the table round until the pin drops into the next succeeding hole. When the required compression has been made by the plungers, the table is moved forward one aperture, thereby bringing another chamber with a fresh supply of peat to be pressed; at the same time that the fresh apertures are brought beneath the compressing plungers the aperture containing the compressed blocks is brought underneath the expressing plungers, which descend simultaneously with the compressors, and force the compressed peat out of the aperture on to a travelling belt. This machine makes a very dense fuel, and it is a machine embodying many details which are now used in the latest machines, on which account we have described it so minutely.

Aschroft and Betteley's System.—In this process of manufacturing peat fuel the inventors separate the fibrous from the thoroughly decomposed portions of the peat by combing, by that means reducing it to a pulp, which is conveyed to a tank, where it is allowed to remain till, by its own weight and pressure, it becomes sufficiently dense to be formed into blocks.

The plant of the American Peat Company, of Boston, had a triturating machine 36 inches in diameter by 4 feet 6 inches high. A central shaft was provided with cutting knives, and the cylinder was furnished with fixed knives in the usual manner in this class of machine. At the bottom of the cylinder was a sliding door, worked by a lever, through which the peat was discharged into the combing machine. The combing machine consisted of a semicircular cistern 6 feet long and 3 feet 6 inches in diameter, inside which was a revolving shaft fitted with arms placed at about 1½ inch pitch, the arms being 1 foot 8 inches long, reaching, therefore, within 2 inches of the bottom and sides of the cistern. Another shaft, provided with arms of similar dimensions, was placed at an angle of 45° with the former; the centres of the two shafts were 2 feet 2 inches. The arms of the two shafts were arranged to run between each other, and both shafts revolved in the same direction. The second shaft was made to rotate at twice the speed of the former. At the bottom of this apparatus was fixed a grating through which the cleaned peat was discharged into the kneading machine. The kneading machine consisted of an iron cylinder 16 inches in diameter by 7 feet long, provided with a spiral screw consisting of discs having a pitch of 6 inches.

Versmann's System.—This consisted of a perforated conical wrought-iron cylinder, inside which was rotated a cast-iron cone A, fig. 15, provided with two spirally shaped knives. The peat was introduced through a hopper K, and cut and forced downwards by the spiral knives, and squeezed through the perforations in the cone. The peat which passed through was collected on the inclined cone in the chamber D, from which it was removed by means of a screw conveyor to the moulding machine. The fibres and heavy stuff passed away through the tube E into the space C, from which place it was returned to the hopper of the machine, to be reduced till it could pass through the perforations. F is a central shaft guided at the top in the bearing L, and at the bottom in the footstep M. The shaft is rotated by the pulley G, pinion H, and bevel wheel J.

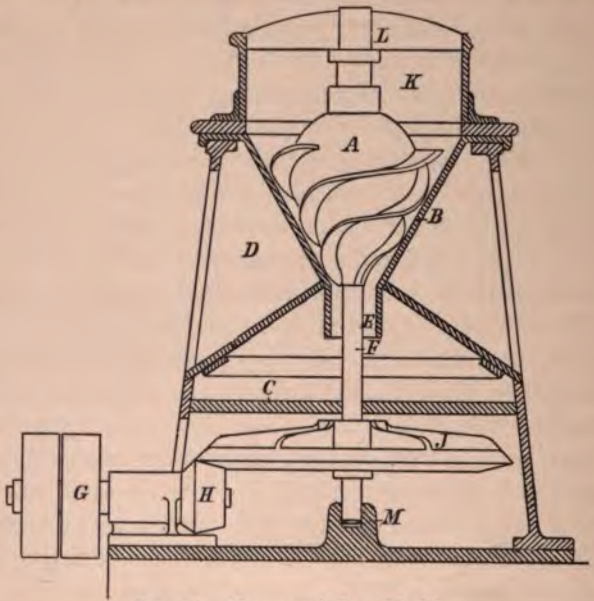

FIG. 15.—Versmann's Peat Machine.

Buckland's System.—This system consisted of a solid cast-iron cone having round its exterior surface a spiral-shaped groove, rotating inside a vertical hollow wrought-iron cone. The peat was introduced into a hopper and passed down between the two cones, and by the rotation of the inner cone the peat was forced through the perforations in the outer cone. According to Professor Johnson, a machine of this description was tried near Boston, United States, but was abandoned as being uneconomical. The ground peat was moulded by hand.

Hodge's System.—This system was invented by Mr James Hodges, of Montreal, Canada. It consisted of a floating barge on which was erected the whole of the necessary machinery; it was about 80 feet long, 16 feet beam, and 6 feet deep. The hull of the vessel was fitted with screw excavators in the front end of the barge, which were 11 feet in diameter, driven through gearing by an engine placed in the stem of the vessel. These screws cut their way through the bog, forming a channel 19 feet wide and from 4 to 6 feet deep; and as the water flowed into the channel as fast as the peat was taken out, the vessel floated and moved onwards as the screws advanced, usually at about the rate of 15 feet per hour. The screw elevators were arranged with shields, cutting plates, knives, gauge plate, and scrapers. The rate of feed given to the excavators could be increased from 1½ up to 4 inches per each revolution, according to the density of the peat. The peat was delivered into the barge, and two men were employed to clear the peat of any pieces of wood, roots, or other useless material fed in by the excavators. When the peat was cleaned it was elevated by chain and buckets into a hopper, into which the material was discharged. At the bottom of this hopper was a screw which passed the material on into a feeder, in which a shaft, reaching from end to end, was rotated; the shaft was provided with blades. Within the feeder were fixed bars, so applied as to direct sticks and similar refuse matter out on one side, acting in conjunction with the revolving blades. A trap was arranged so as to regulate the exit opening from the feeder, according to the amount of refuse to be separated from the peat. A receiver for the refuse matter was fitted with a valve which was opened from time to time to let out the refuse. The material was delivered as it passed out of the feeder into a trough fitted with fixed knives and a revolving shaft with knives, and at intervals at its bottom were sliding doors which could be opened at pleasure for the escape of the material on a previously prepared ground along the banks of the channel that was cut out, and distributed in layers.

When the peat was sufficiently dry, it was cut into regular blocks. The barge was propelled forward, as the cutting proceeded, by means of a drum worked by the steam engine. The rope was secured to an anchor ahead of the barge.

The screw excavators were driven in opposite directions, their shafts being geared together by a cross-shaft which was geared with another cross-shaft, and from this, by an inclined shaft and suitable gearing, was driven the elevator.

The peat, which was fed into the hopper in lumps, was broken up in the feeder, into the separator, and by means of a hand pump sufficient water was added, if necessary, to ensure the thorough pulping of the material in the trough. The shape of the knives in the feeder and in the distributing trough was such that whilst one edge of each revolving knife cuts the fibre of the peat between itself and one of the fixed knives in the manner of a pair of shears, the other edges of the knives crush the fibre between itself and the flat side of the next diaphragm, against which it is forced by the spiral action of the revolving blades.

Hodgson's System.—Mr C. Hodgson employed for compressing peat a machine patented by him which he described as a horizontal reciprocating ram, working in a cylinder 5 feet long; as the ram was drawn back at each stroke the powdered peat fell into it, and filled the whole length, considerable friction taking place against the sides of the cylinder before the frictional resistance of the column was overcome. The whole mass moved on, so that the blocks formed at one end were successively discharged at the other, at the rate of sixty per minute, making in an hour about 15 cwts. of compressed peat fuel, equal in density, it was said, to coal. A machine of this description was in operation at Derrylea, near Monasterevan.

Zohrab's System.—The system invented by M. E. Zohrab is illustrated in sectional elevation, fig. 16. The peat is crushed in a mill A, then it is kneaded and moulded in the machine B, and finally dried in the chamber C. The peat is crushed by means of cast-iron blades E fitted to the vertical revolving shaft F, rotated in bearings G and H, and the blades J attached to the interior surface of the cylinder A. The vertical shaft is rotated by the bevel wheel and the pinion, keyed on a horizontal shaft. The crushed peat, in a plastic condition, is forced through the perforated plate N by the Archimedean screw O, falls on to the travelling belt P, and is carried to the moulding machine B. The peat is kneaded in this machine B by the arms R, mounted on the vertical rotating shaft S, and worked between the fixed arms T. The peat is forced through the lateral moulding aperture U by the screw V and cut into blocks by a knife, wire, or other suitable means. The blocks are carried away by the travelling belt W through the drying chamber C, supplied with hot or cold dry air by pipes arranged at intervals along the sides of the chamber.

Gerard's System.—A very elaborate installation for the manufacture of peat fuel was invented by J. M. A. Gerard. The peat, after it had been cut from the bog, was disintegrated by a pug mill, and the disintegrated peat, mixed with water, was run into settling tanks, in which any sand or clay present with it subsided. The peat pulp was next made to travel upon a metal gauze band, mounted on an

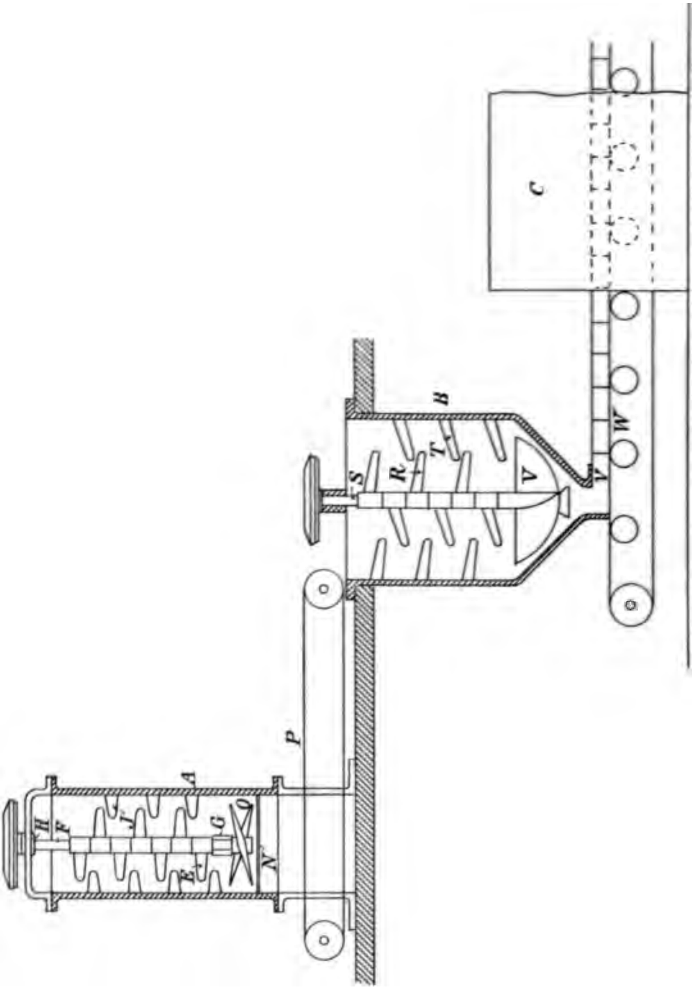

FIG. 16.—Zohrab's Peat Mill.

oscillating frame. On leaving the frame the layer of peat passed under a roller, between that and an additional

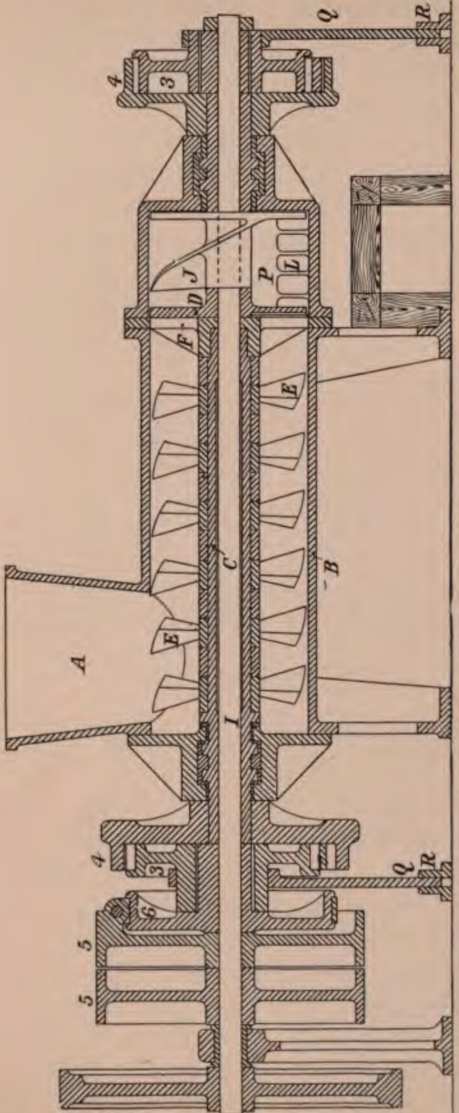

FIG. 17.—Hall-Bainbridge Peat Machine—Sectional Elevation.

end. All the propelling arms are flat on the face, and their spiral arrangement is such that they act effectively to keep the peat in motion rapidly forward through the machine.

This machine has five moulding orifices which are all formed in one die, bolted to the mouth of a chamber. Beneath the chamber is a roller table, on which boards or trays are placed to receive the moulded peat. The boards or trays of peats are conveyed along the roller table until they are opposite drying racks, when they are lifted off on to and placed on the latter, where they remain about three days. After that period of time the peats are placed upon open shelves for final drying. On an average it takes about three weeks before they are well dried and ready for use.

Gwynne's System.—This system consists in depriving the peat of a large percentage of water by means of a centrifugal, after which it is ground to powder, and passed through a series of cylinders revolving in a heated chamber, to evaporate the remaining part of the water. When the peat has been subjected to a temperature of about 180° F., it is compressed into blocks.

The peat to be manufactured into fuel is fed into the mill, where it is prepared. From thence it is passed by a chute into an elevator, from whence it is conveyed by elevator buckets to the top pair of a series of cylinders. These cylinders are driven by a pulley, and the rotary motion is transmitted throughout by a series of spur wheels keyed on to the ends of the cylinder shafts. A furnace gives the necessary heat to the cylinder for effecting the drying of the material. The interior of the cylinders, for the purpose of agitating, mixing, and propelling the peat under treatment, was fitted with ribs or screw blades. As the cylinders revolved, the peat travelled along them and fell from one to another until it arrived at chutes, through which it passed into a chamber thoroughly dried.

After this operation the dried peat was ground and passed into the compressing machine. The main driving shaft is carried in bearings on vertical frames, and has keyed on to it a driving pulley and fly-wheel. This shaft carries also two spur pinions, which give motion to spur wheels, keyed on to the ends of the shafts. A strong cast-iron standard bolted to beams carries the shafts in the bearings. Each of these shafts is fitted with an eccentric, which is connected with compressing plungers by tightening brasses. The moulding table is actuated by a spring catch, which consists of a lever, working loose on a tubular centre underneath the table. A spring catch fitted with a projecting pin is fixed to this lever by a screw. The pin projects through the lever into indirect grooves, formed in the raised portion of the table. One edge of the lever is inclined for the purpose of raising the end of a spring detent, which is secured at its extremity to the standard. This spring is fitted with a stud pin which is pressed into one of a series of holes formed in the table; by this means it is held steady during the compression of the peat, which is effected in the rectangular openings; the outer end of the lever is attached to a connecting rod, which is jointed at its opposite extremity to a vertical lever arm. This lever works on a fixed centre, and is guided by a forked or slotted guide, bolted to one of the beams. The necessary vibrating motion is transmitted to this lever by a connecting rod, which is attached at one end to the free extremity of the lower arm, and at the other end it is connected with a crank fitted on the end of a short shaft; a steam pipe communicates with the interior of the moulding table for the purpose of heating the same. To effect this the table is cast hollow, with a plate or cover bolted over it, the waste steam passing off by a pipe. The compressing plungers work in fixed guides, which are bolted to the frame; each carries a stud which passes through a lever, working on a fixed centre on

end. All the propelling arms are flat on the face, and their spiral arrangement is such that they act effectively to keep the peat in motion rapidly forward through the machine.

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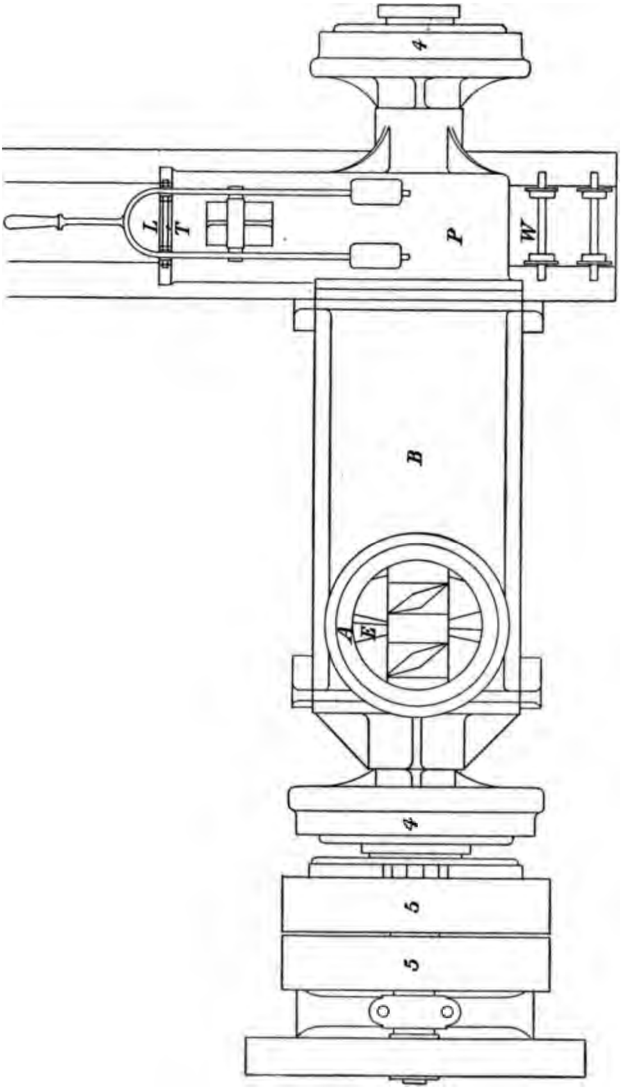

FIG. 21.—Hall-Bainbridge Peat Machine—Elevational Plan.

was 11 revolutions per minute; and these motions were effected by differential gear shown in section, fig. 17, and end elevation, fig. 19. An eccentric, 2, was formed on the shaft I; a wheel, 3, having, say, thirteen teeth, was mounted loosely on it. An internal toothed wheel, 4, was keyed to the outer shaft C, and had thirty-three teeth. The throw of the eccentric was such as to cause the pitch line of the wheels to exactly coincide as the eccentric revolved; but the wheel 3 was prevented from turning round by the tail-lever Q, to which it was firmly secured and held in the bracket R, in which it moved. The action of this was to revolve the outer wheel for each revolution of the eccentrically mounted pinion, in the proportion of the difference of their teeth. It might be termed an internal sun-and-planet motion. Motion was given to the belt pulley, 5, and transmitted through a friction strap and drum, 6, to the pinion, so that the driving could be nicely adjusted to the power

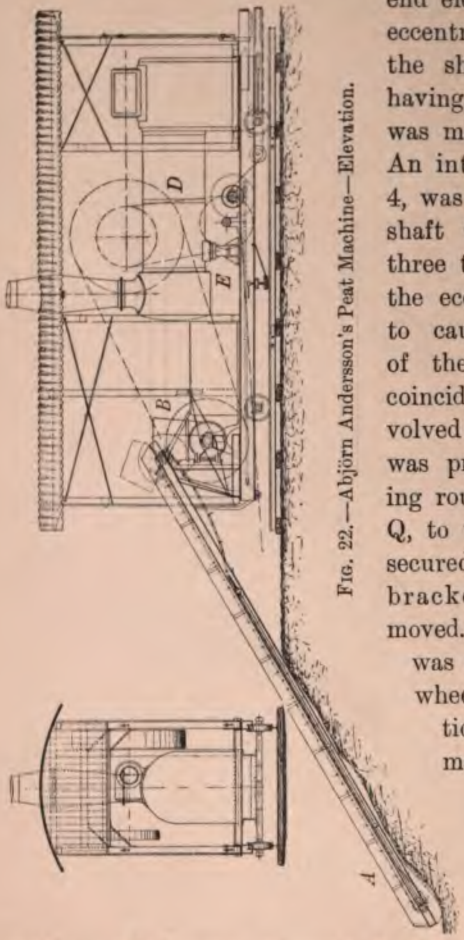

FIG. 22.—Abjörn Andersson's Peat Machine—Elevation.

required for treating the peat; but in the event of any foreign substances being present, or undue strain being brought on the machine, it would slip, and thereby call attention to it before damage was done.

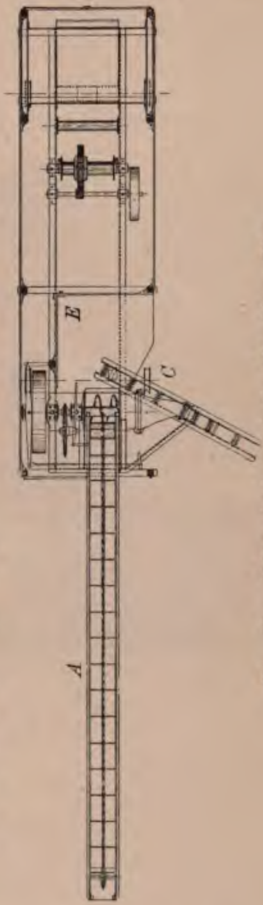

FIG. 23.—Abjörn Andersson's Peat Machine—Plan.

Åbjörn Andersson's System.—This plant is shown in elevation, fig. 22, and plan, fig. 23. This consists of an elevator, A, which digs the peat from the bog into a macerating machine B, in which the peat is made into a kind of pulp and moulded into bricks, which are removed on a roller table C or continuous belt. The elevator, macerating machine, roller, and the steam engine D, or electric motor, as the case may be, are all mounted on a trolley E, which is moved forward on the bog, as the peat is cut out, by means of a small windlass, rope, and anchor.

The macerating machine is illustrated in fig. 24, showing the machine opened for access to the working parts. It consists of a hopper into which the peat is dumped by the elevator. The peat then falls on to a screw conveyor, forcing it into the macerating chamber, where it is forced against knives, fixed radially. The screw at the mouth is provided with a sharp cutting edge, so that the peat is cut in pieces, against an adjustable steel cutter, before it enters the macerating chamber. The screw finishes a distance of from 3 to 4 inches from the end of the chamber, according to the quality of the peat. The fixed knives are joined in the centre to form a bearing for the screw shaft. On the shaft is a boss, brought up to the end of the screw, fitted with a knife which, as the shaft revolves, cuts the peat against the edge of the fixed knives as it is forced forward. The fixed knives are also provided on the outer side with cutting edges, against which work radially-placed rotating knives, which are keyed on the shaft. These knives are screw-shaped, so as to assist in propelling the cut peat forward. This macerated peat is then taken hold of by a double-threaded screw, and forced through a taper-piece, and towards the mouthpiece, in the usual manner. If we take a machine

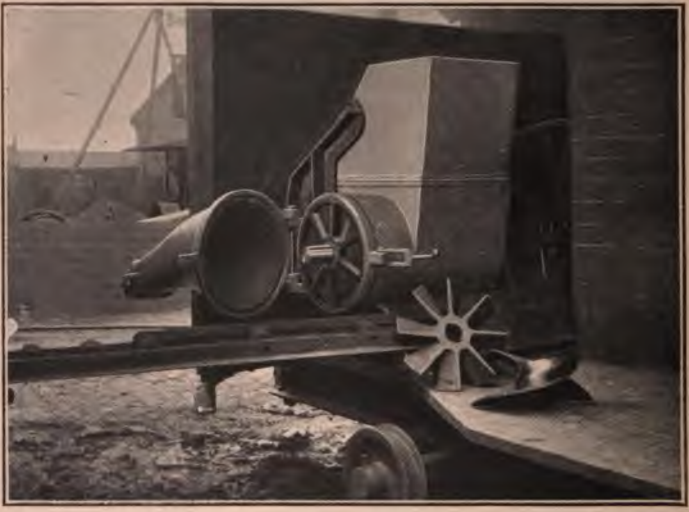

FIG. 24.—Åbjörn Andersson's Peat Macerating Machine.

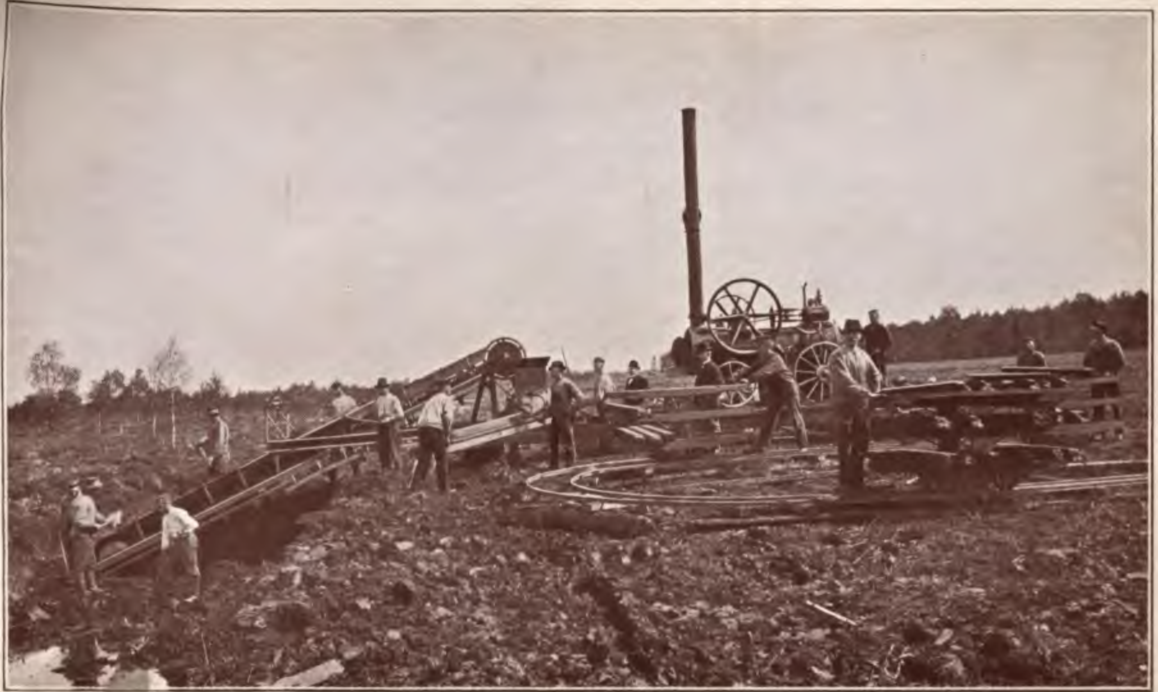

FIG. 26.—Åbjörn Andersson's Peat Plant at work on the Elmhult Bog, Sweden.

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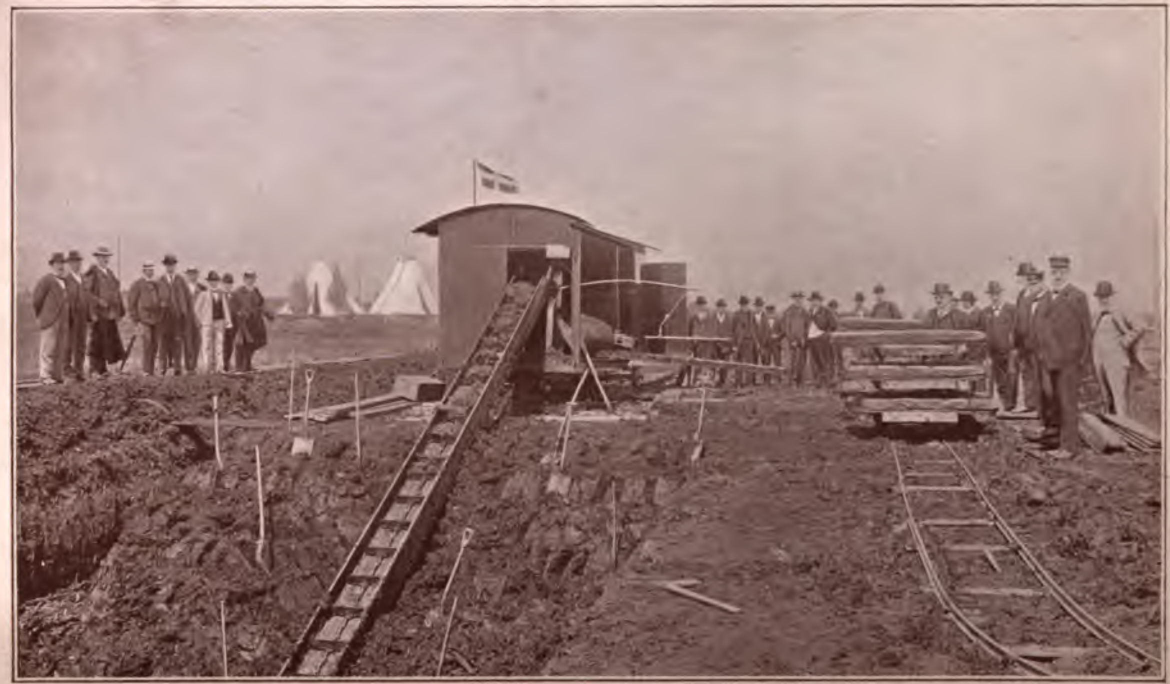

FIG. 27.—Åbjörn Andersson's Electrically-driven Peat Plant at work at Stafsjö, Sweden.

with nine fixed and nine rotating knives, one on one side and eight on the other, we get 9 by 9, that is, 81 cuts for each revolution; and when the shaft makes 150 revolutions per minute we get 81 by 150, or 12,150 cuts per minute, and according to the speed of the feed the material is cut in pieces, $\frac{1}{8}$ to $\frac{5}{32}$ of an inch in length, all through the mass. The portion of the machine containing the double-threaded screw and the mouthpiece is hinged so that when examination or repair is required it can be swung out of the way and all the machinery got at.

The rails upon which the whole of the machinery travels are made about 10 feet in length, so that the rails can be pulled up and laid in the front of the trolley before it has been moved too great a distance from the bank of the bog which is being cut.

The various knives and screws are shown in fig. 25.

Fig. 26 illustrates one of Åbjörn Andersson's plants at work on the Elmhult Bog, in Sweden, and an electrically driven plant at work at Stafsjö, in Sweden, is illustrated in fig. 27.

Anrep's System.—The Anrep machine, as manufactured by Munktells, in Sweden, is illustrated in fig. 28. This machine is divided into two parts; the first, into which the peat enters through a hopper, is provided with cutting knives, the other with propelling screws. There are two shafts passing through the machine on which the knives and screws are secured; these shafts running towards each other, being driven by a pulley and two spur wheels, the macerated peat being forced out through a mouthpiece common to the two cylinders. The material is subjected to 7700 cuts per minute, so that any sticks or thick roots are easily cut by this machine and mixed with the peat. The peat as it is forced out through the mouthpiece is cut off in pieces about 13 inches long by $4\frac{1}{2}$ inches wide and 5 inches thick. After air-drying, these peats contain 20 per cent. of moisture—about the same amount as air-dried wood—and shrink to about one-eighth of the original volume they occupy when they leave the machine. Each peat weighs about 1 kilogramme = 2 lbs. 3 ozs.

Fig. 29 is an illustration showing one of these machines on Stafsjö Bog, near Ljubgby, in Sweden. Above five hundred machines of this type have been made, most of which are working in Russia. The arrangement of the plant is somewhat similar to the Åbjörn Andersson's, illustrated in figs. 22 and 23.

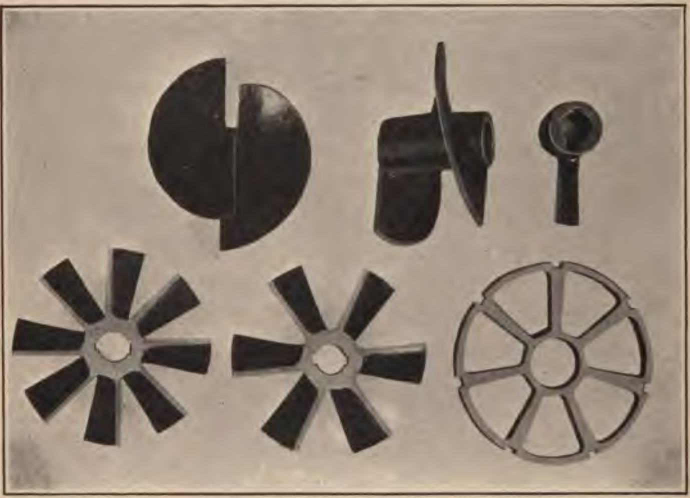

FIG. 25.—Various Knives and Screws used in Åbjörn Andersson's Peat-macerating Machine.

The Anrep machine is made in two sizes. One size produces 60,000 peats per day, or about 60 tons of air-dried peat, if the bog is drained and the peat is easily worked, *but* only about 50 tons if the peat is poor. The smaller

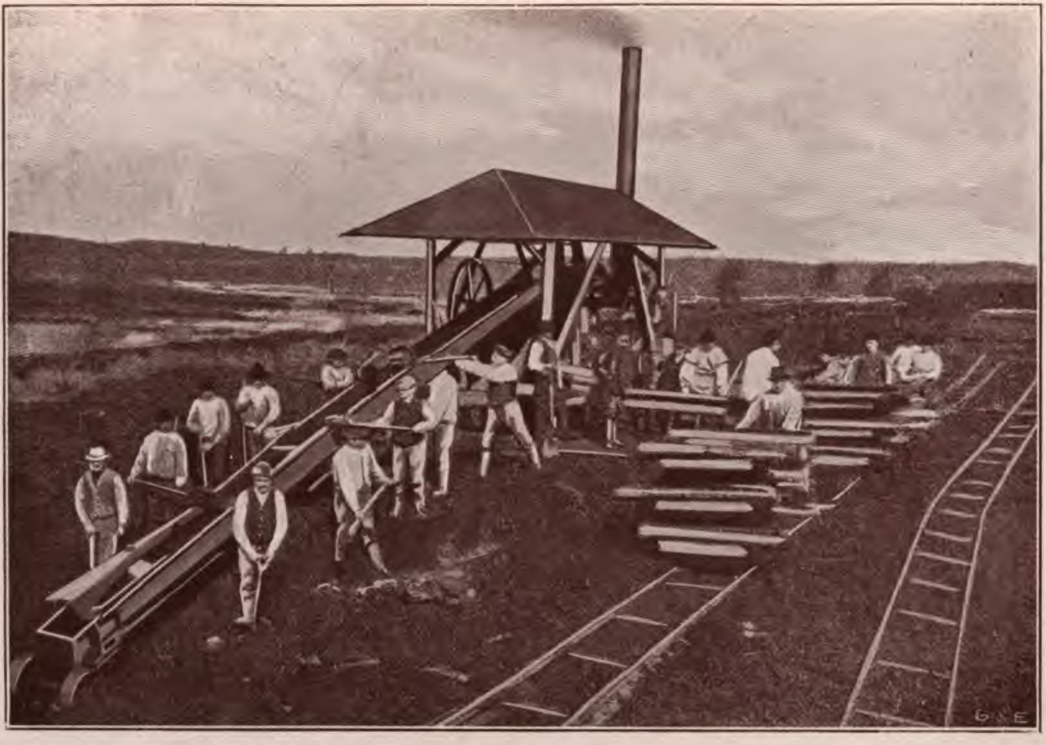

FIG. 29.—Anrep's Peat Machine at work on Stafsjö Bog, near Ljubgby, Sweden.

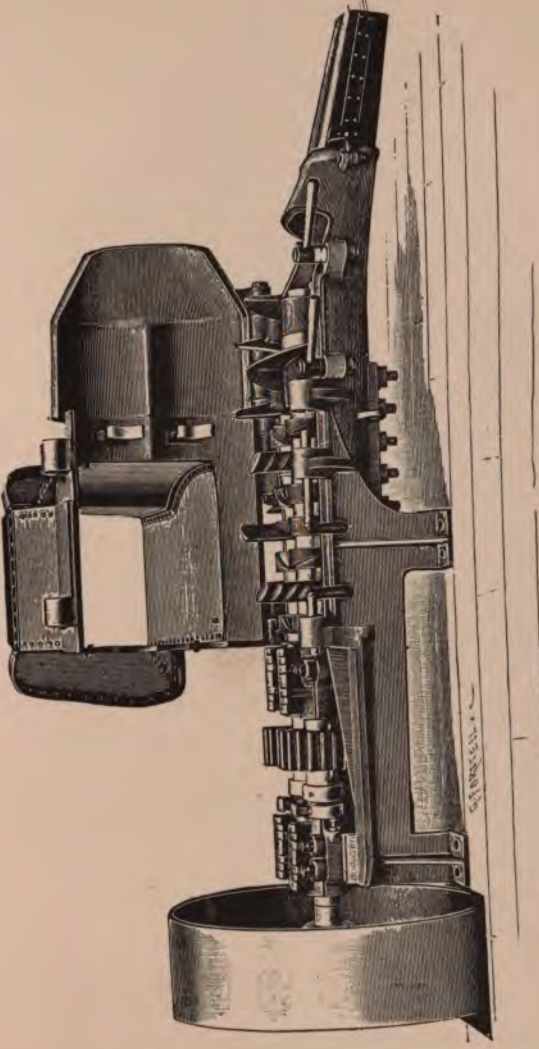

FIG. 28.—Anrep's Peat Machine.

size produces 30 tons of air-dried peat per day, requiring 23 effective horse-power.

The cost of manufacture of the peat by one of these machines at Stafsjö, according to Mr Aug. E. Jakobson, is 2·11 krone (2s. 7d.) per ton. The cost at Hästhagen, according to Mr Thure Björkman, is 2·15 krone (2s. 10d.) per ton.

Åkerman's System. —This is another Swedish machine similar to the last two systems. It consists of an elevator, which is easily adjusted to the varying depths of the bog as the digging proceeds. This elevator delivers the peat cut from the bog in lumps of any size and shape with an ordinary spade, into a hopper of the macerating machine. The hopper is made of thick wrought-iron plates strengthened with angle irons, the sides being made sloping to allow the peat to fall readily into the machine. The sides are also made very high to prevent the peat being thrown over on to the machine underneath. The elevator is driven by means of gearing, sprocket-wheels, and detachable chain from one of the cutter shafts of the machine.

The turf, as it falls into the body of the machine, is cut up and worked to a paste by means of rotating sword-shaped knives, which are secured on to two nearly parallel rotating shafts. The shafts are carried in bearings which on the lower parts are shaped into knives corresponding with the sword-shaped knives. The latter work also against knives placed at the bottom of the machine body. By means of this arrangement of knives the roots and small branches are cut up and kneaded into the mass of turf.

After the turf, etc., has been macerated and worked into a paste it is forced forward and compressed by means of two screw conveyors at the ends of the shafts, through a mouthpiece or mould, and discharged on a roller band of iron. This band or conveyor is fixed immediately under the mouthpiece, at a slight angle to the centre line of the machine, so that the peat frames can be easily placed upon it.

The body of the machine consists of an upper and lower part, which are hinged together and secured by a hasp, so that it can easily be opened up for examination and repairs.

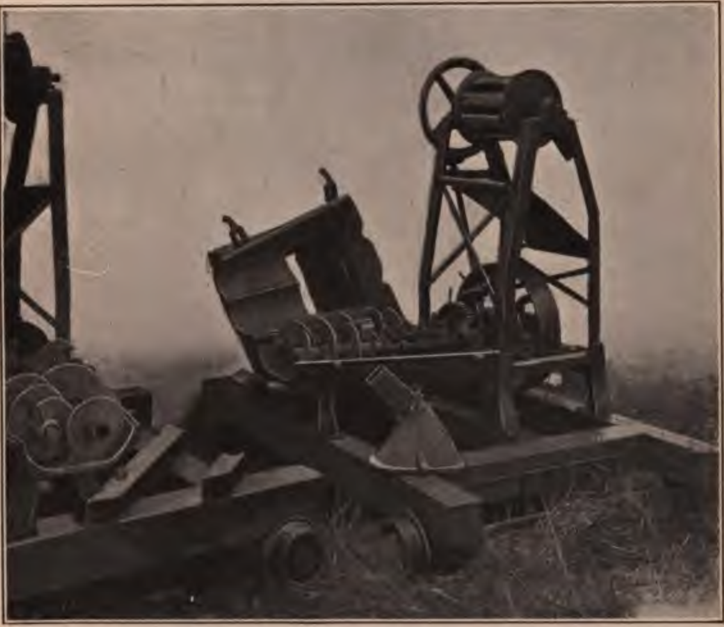

FIG. 30.—Åkerman's Peat Machine, showing Internal Arrangement.

Fig. 30 illustrates this machine opened out to show its internal arrangement, the mouthpiece being placed at the front end of the wood frame.

Fig. 31 shows the machine at work mounted on wheels.

These machines are made in three sizes. The smallest machine will make about 16 tons per day; 13 actual

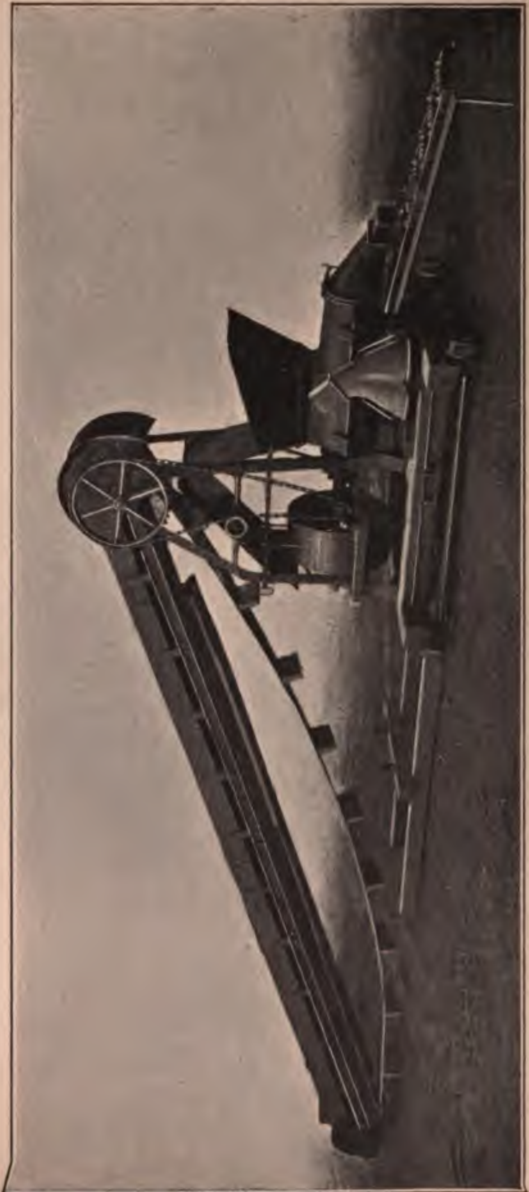

FIG. 31.—Åkerman's Peat Machine at work, mounted on Wheels.

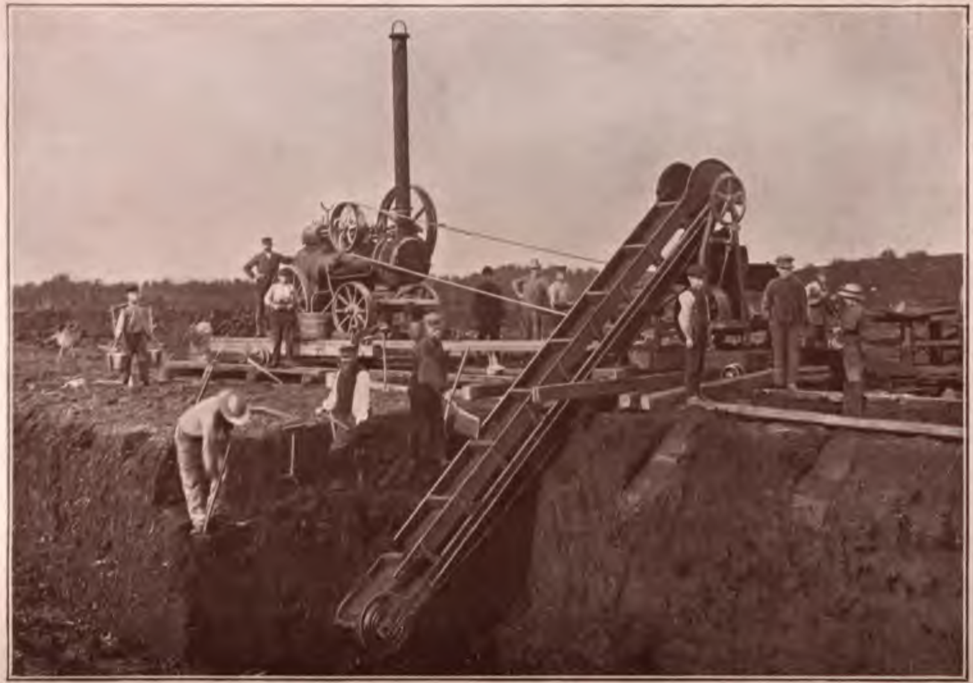

FIG. 32.—Åkerman's complete Peat Plant at work at Hyllstofta, Sweden.

horse-power and 8 men and 2 boys are required to do the work.

The medium size will manufacture about 24 tons per day; 19 actual horse-power and 12 men and 2 boys are required.

The largest machine will produce 32 tons per day; 27 actual horse-power, and 16 men and 2 boys are necessary to attend and drive this machine.

The size of the peat stream issuing from the machine is, in the large machine, 4½ inches by 4⅞ inches; medium machine, 3⅞ inches by 4⅝ inches; and the small machine, 3⅝ inches by 3⅞ inches.

Fig. 32 illustrates a complete plant at work at Hyllstofta, Sweden.

Exter's System.—This system was first employed in Germany. The bog was first drained, and the part to be worked was levelled. Next, the surface was harrowed, either by manual labour or by steam power. This harrowed material was partially dry on account of the sun and wind, and was arranged in small heaps in the form of fine mould. The fine loose peat was then removed to a large storehouse, where it was kept, so that it could be manufactured into fuel during bad weather. After this it was removed into another building, where it was artificially dried, and brought forward through a chute into a compressing machine. By this means the fine peat was solidified into a good hard peat fuel.

The most modern design of Exter's machine is illustrated in sectional elevation (fig. 33) and end view (fig. 34). The fine mould is admitted through the hopper A into the mould B by gravity. This mould is made in four pieces of hardened steel. It is held in its place by screws to give the proper tension to the retaining plate C. This is effected by means of the hand-wheel D, worm E, and worm-wheel F. The piston or pusher G is operated by an eccentric and steam engine or other motor. When the piston G is withdrawn, the proper amount of peat mull enters the mould, and on the forward stroke the piston presses against the block left in the mould by the previous forward stroke. These presses make from 65 to 80 strokes per minute, each stroke producing one block at a pressure of about 2 to 2½ tons per square inch.

Dobson's System.—After the surface of the bog has been stripped of the useless material, the peat is cut by an automatic digging machine. A trench is first cut in the bog, and the machine placed close to the edge, a link belt, furnished with knives and scrapers, overhanging the machine, reaching to the bottom of the workings. These knives and scrapers deliver the cut peat into a hopper, from whence it passes to the other side of the machine by a conveyor. During this cess the machine is continuously moving forward very

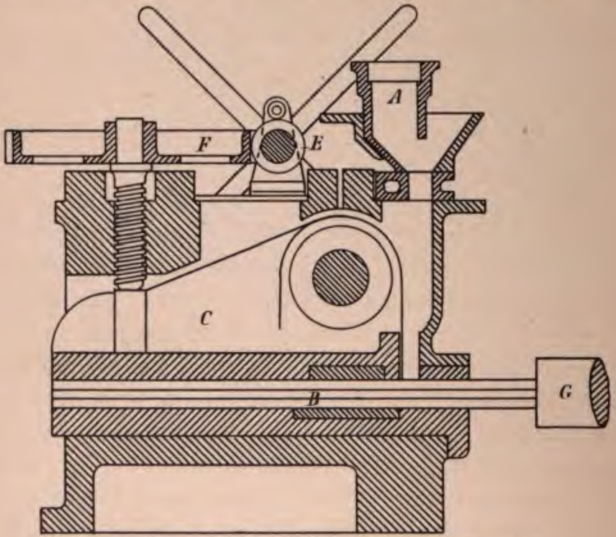

FIG. 33.—Exter's Peat Machine—Sectional Elevation.

slowly, always presenting a fresh cutting surface, in the banks of the bog, to the knives and scrapers. The machine is mounted on very wide road-wheels. The peat, as it is discharged from this machine, is raked out into beds and allowed to rough dry. When it is ready it is thrown into wagons and drawn into the mill. The peat is next thoroughly dried in Dobson's Patent Dryer, explained and illustrated in Chapter IX. From the dryer the peat is dumped into a breaking machine, and lastly pressed in one of Dobson's presses.

The Dobson Press is of the vertical closed tube type, the die resting on a solid base. The briquettes are allowed to remain in the dies for one cycle of the system, and are then subjected to another compression by a second briquette formed on the top of it. There are two formers or punches in each machine, and to each former a die block containing eight dies. The frames are actuated by eccentrics. The die blocks and press-bed of one of these presses is shown in elevation—half sectional—fig. 35, and plan, with one of the die blocks removed, fig. 36. A and A are the formers, B the expelling punch, C the resistance block, which yields when the stress exceeds the working pressure, the springs D taking up the excess pressure and preventing any breakage. E and E are the two die blocks, which are rotated by the reciprocating lever F and the ratchet G. H is an oil-swab which

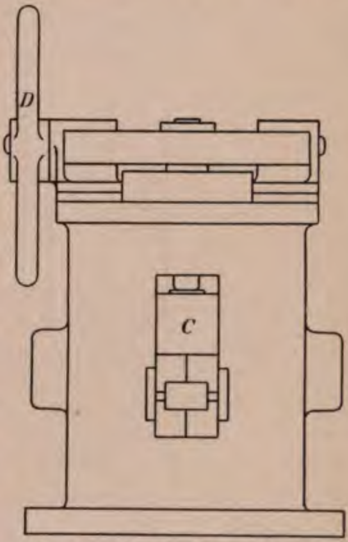

FIG. 34.—Exter's Peat Machine —End View.

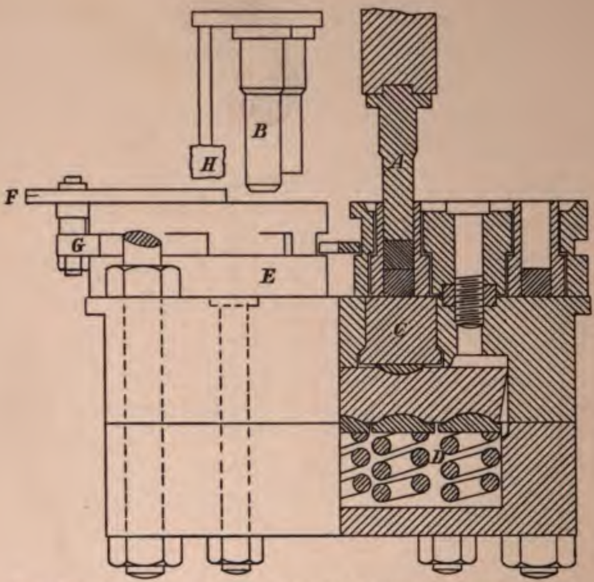

FIG. 35.—Dobson's Peat Machine—Half Sectional Elevation of Die Blocks.

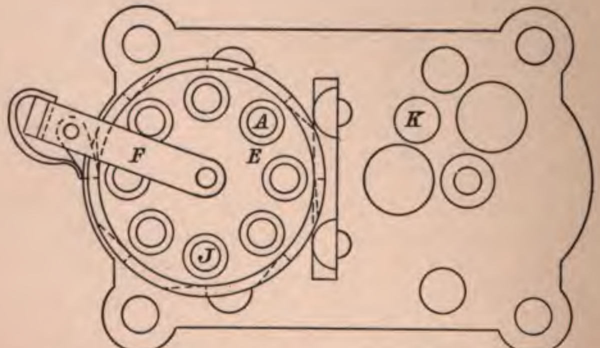

FIG. 36.—Dobson's Peat Machine—Plan, with one of the Die Blocks removed.

lubricates the die before the peat enters it. J are the dies, and K the discharge hole.

Dickson's System.—In this process the peat is dug out by a dredge, and is piled in heaps on the bank for air-drying. After two weeks or so, according to the state of the weather, it is removed to barges, which are towed to the works. The amount of water is then reduced by a pressure of 300 tons applied to one ton of peat at a time. These solid blocks are delivered into a screw conveyor and broken up, so that they can be transported by a chain conveyor, which delivers the peat into a breaker. This machine consists of a number of arms or knives secured to a shaft in such a manner that when the latter revolves the arms of the former shaft fly out by centrifugal force and beat violently any lumps within their reach. By this means the peat is reduced to powder and fibres and passed into a dryer.

After drying, the peat fibres and powder are introduced into one of Dickson's Peat Presses, to be made into blocks. The die-block is illustrated in sectional elevation, fig. 37. The action of the press is as follows:—Steam being admitted on one of the cylinders, the movement of its piston revolves the crank shaft and valves and brings the other cylinder into operation as well; then the pistons proceed to work in opposite directions, imparting such movement to the formers A that one will be exercising the formative pressure upon one charge of material in one tube, while the other is receding and another charge of material is falling to the mouth of the other tube. When the tubes are fully charged, which becomes the case after a few strokes of both formers, one new block is formed at the upper end of each tube against the yielding resistance by the previously formed block, still retained, and one finished block, or more, according to the thickness of the blocks, which varies according to the difference in density of the raw peat, is ejected at the lower end of each tube at each stroke of its former. In the machine for operating upon cold dry peat the total approximate length of the forming tube may be taken as 12 inches, and the actual entrance stroke of the former limited to 5 inches, and as the stroke of the piston is 14 inches and the travel of the crank 21 inches, it will be seen that in the double press the whole power of both cylinders is transmitted through the crank shaft and imparted to each block formed, 23 inches travel being free from resistance in each engine, one of which comes into play midway of the other's travel,

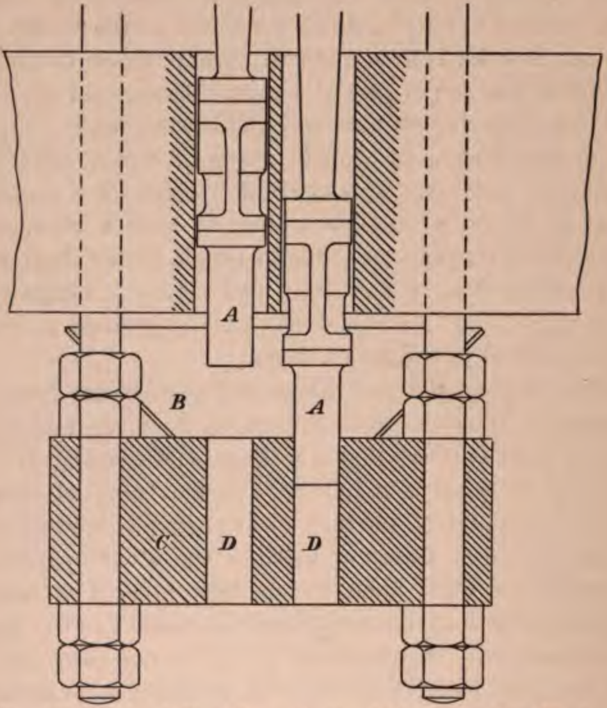

FIG. 37. —Dickson's Peat Press—Sectional Elevation of Die Block.

and thus does not impair the speed of operation of the double machine.

The material is fed into the dies by a separate hopper B for the two dies, arranged immediately above the die-block C, and so designed that the feed of the material may gravitate between the two die-members in successive charges. The die-block has two forming tubes D and D, provided with parallel steel bushes, so that the peat does not receive any lateral compression after it has been set into a block by the vertical stroke of the former. The die-block is made hollow, and a stream of water is allowed to circulate through for the purpose of keeping it cool.

Each punch or former makes fifty-four to sixty strokes per minute, and the combined output of one press ranges from 8½ to 9 tons per day of ten hours, or an average of 8¾ tons of briquettes per day.

Düsseldorfer Eisenwerk Aktiengesellschaft System.—This company has adopted the Schlickeyesen or Dolberg press, shown at A in fig. 38, into which the moist fresh-cut crude peat is fed, and converted into a homogeneous pulp, which is discharged from the copper mouth of the press, as a continuous stream of fibrous material, about 2 feet wide and from 1½ inches to 1 inch in thickness. From this it is carried forward by the conveyor belt to the cutting table C, which cuts it into lengths of about 2 feet and 1½ to 2 inches thick. The blocks are next delivered into an intermittently revolving apparatus D, which in turn discharges them through a shoot F into a bagger arranged in such a manner that the blocks of peat are entirely untouched by hand. The bagger consists of a pillar G, carrying a double arm, with the shaft J, and the stretcher bars K K, all mounted so as to be able to be rotated. Two men are required to work the bagger, one on each side of the machine. The man on one side places an empty bag on the stretchers K K, and sets these lat

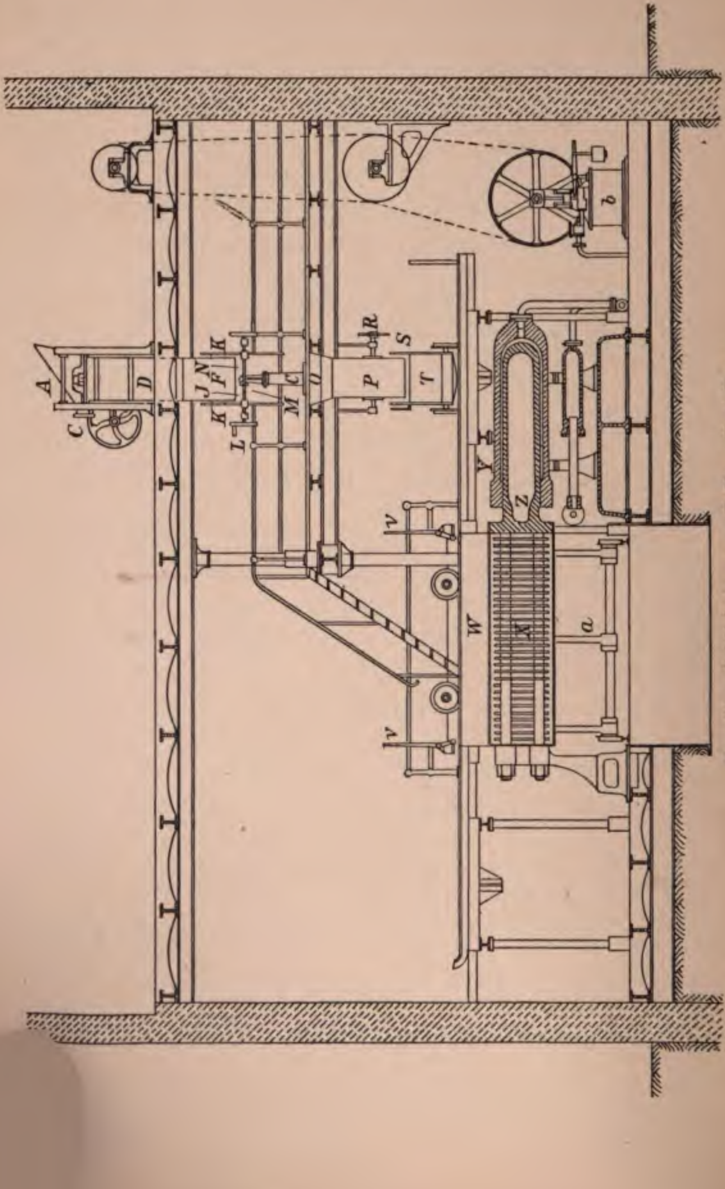

FIG. 38.—Schlickeyesen or Dolberg Peat Press.

tension, so as to fasten the bag in position; when this is done he turns the hand-wheel L, in order to turn the double arm H in the opposite direction. By this movement the wheel M revolves on the wheel N, and the stretcher bars, which were directed upwards before the commencement of the movement, are turned downwards, thus bringing the bag into the proper position for receiving the blocks of peat. As soon as the block is in the bag on that side, the man releases the stretcher bars K K by means of the hand-wheel L, and the bagged block falls through hopper O into a rotary double chamber P, which is divided by a central partition. At the same instant the double arm H is again turned, thus bringing the stretchers on the opposite side into position for setting on a fresh bag.

The rotary double chamber P receives the bagged peat blocks in such a manner that on turning the hand-wheel R the 4 inches or so of bagging that projects beyond the end of the block is laid against the sheet-iron casing S, thus closing the mouth of the bag. The latter with its contents is then discharged into a truck T, divided into about thirty compartments, and moved forward automatically as soon as each compartment is filled. When the truck is loaded, it is run into position over a hydraulic press into the compartments of which the contents of the truck are discharged by moving levers V V, so as to displace the slotted plate forming the bottom of the truck, and thereby open all the compartments at once. The bagged blocks of peat thereupon fall down the guide compartments W, and enter between press plates X into the press, which chiefly consists of the cylinder Y and the ram attached to the ram-head Z. The plates of the press are connected with one another and the ram-head by means of chains, so that when the pressing is finished, and the ram and the ram-head return, the plates are drawn out again to their original position. Under the press plates is a truck A, which is mounted on wheels and runs on a railway, for the purpose of preventing the bagged peat blocks from falling out of the press before pressure has been applied. One truck is sufficient for a number of presses. By means of pressure generated by the pumping engine *b*, the press ram is driven forward and thus squeezes the water out of the bagged peat blocks.

The pressed peat blocks now contain about 50 to 60 per cent. of water, fall down out of the press on to a conveyor, and are delivered to a floor where they are emptied from the bags. After this process they are passed through a disintegrator and conveyed to the drying ovens, where their water is further reduced to about 12 to 15 per cent., and whence they are transferred to the briquette presses. The advantage of this form of press for this purpose over the common form is that the bags can be changed without any loss of time.

One of these presses, employing two horse-power, can deal with 324 cubic metres of crude peat in ten hours at a cost, inclusive of digging the peat by hand, of seventh of a penny per cwt.

Lennox's Peat Fuel Process.—In this process it is not necessary to drain the moss or bog, as the patent squeezer removes in one operation much more water than any draining will do. This is a most important item, as the cost of cutting and keeping open the drains runs to an outlay of many thousands of pounds on some of our largest mosses. The peat turfs can be cut any size or shape, or dug by a grab dredger, and it does not matter what the size of the blocks or lumps of wet peat may be, as the squeezer will at once remove the loose moisture and deliver the peat in flat cakes ready to be pulped.

The first machine is a squeezer and pulper combined, and consists of two running converging bands, both travelling in he same direction. The lower band runs on shafts mounted on a rigid frame, and is driven by spur and pinion gear. The top band is fixed to a swinging frame on another driving shaft at the feed end of the machine, and the free end of the frame over which the band passes works under powerful springs. This end of the band and frame can be set down by screws to touch the bottom band running on the fixed frame. The feed opening between the two bands can be made any height according to the size of peat turfs thrown in. The top band is driven by spur wheels from shaft of bottom band. As soon as the peat is thrown on to the bottom band it is immediately carried up between the two bands and gradually squeezed to a flat cake, removing from 20 to 24 per cent. of loose or free water from the wet peat, and the machine will take the peat as quickly as it can be fed into it. When the squeezed peat leaves the machine it falls into a pulper, where it is instantly pulped to the desired consistency, and from the pulper it either falls into drying waggons which, when filled, are pushed straight into the dryer, if the peat is required for making litter or dust, but if required for fuel it is carried to the briquette machine to be made into briquettes.

The converging bands are set at an angle of about sixty degrees to allow the water to run off after it is squeezed from the peat.

Pulping Attachment.—The pulping attachment consists of a number of running knives which are spaced to suit the grade to which the peat has to be pulped. On the present machine the knives are set three-quarters of an inch apart and give excellent results. As mentioned above, if the peat is required for litter it falls straight from the pulper into one of Lennox's patent bogies which fall automatically. These bogies (illustrated in fig. 41) consist of a number of vertical pockets made of strong wire netting, and the pockets are set about two inches apart to form air spaces between each, so that the hot air in the dryer can be driven all round them, thus coming into direct contact with the peat. The bottom of the pockets is closed with a sliding door so that when the peat is dry and has to be emptied the bogie is pushed over a pit, the sliding door drawn, and the dry peat allowed to fall straight into the pit. The bogies are 6 feet long by 4 feet wide, each with ten pockets 2 feet 9 inches long by 6 inches wide and 4 feet deep. The pockets can be made any required size and depth. This method reduces the handling of the peat to the smallest possible amount.

Briquette Machine.—This patent machine consists of a series of mould boxes in groups, or singly, as required, hinged together to form one continuous or endless band driven by cant wheels from spur gearing. At the bottom of each mould box is a movable plunger fitted to a spindle passing through the bottom of the mould box. On the end of the spindle is a cross-head, and on the spindle between this cross-head and the bottom of mould box is a spiral spring which keeps the plunger at the bottom of the mould box. On the top of the machine, directly above the running band of mould boxes, is a feed box into which the peat to be moulded is fed; and by movable flaps, inside the feed box, driven either by the band itself or by gearing from the driving shaft, the peat is forced into the empty mould boxes as they pass under the feed box. The filled mould boxes then travel along and pass under a wheel on which there are dies or panels which fit into each mould, and these dies press the peat firmly into the mould boxes. On leaving this wheel the mould boxes pass over the cant wheel and travel mouth downwards directly above a running band travelling in the same direction and at the same speed. On the same band are fed palette boards for receiving the ulded briquettes when ejected from the mould boxes;

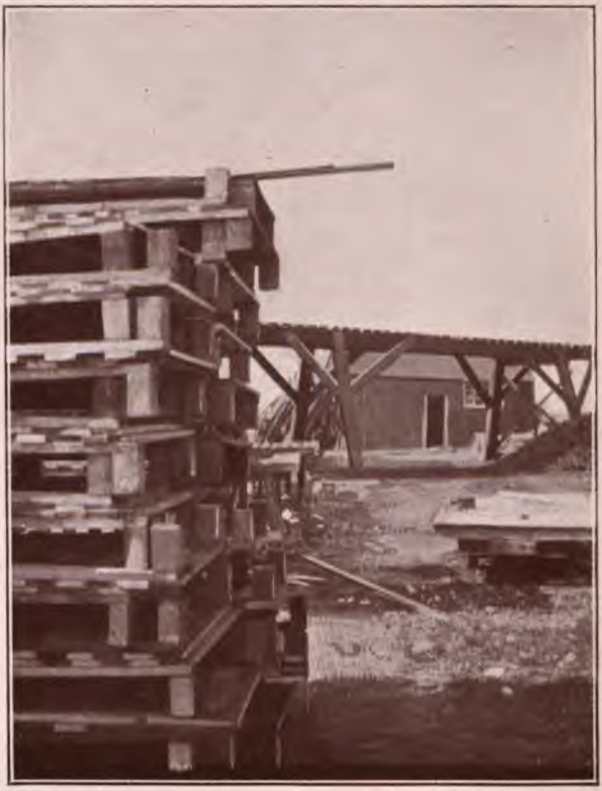

FIG. 40.—Empty Palettes for Air-drying Peat.

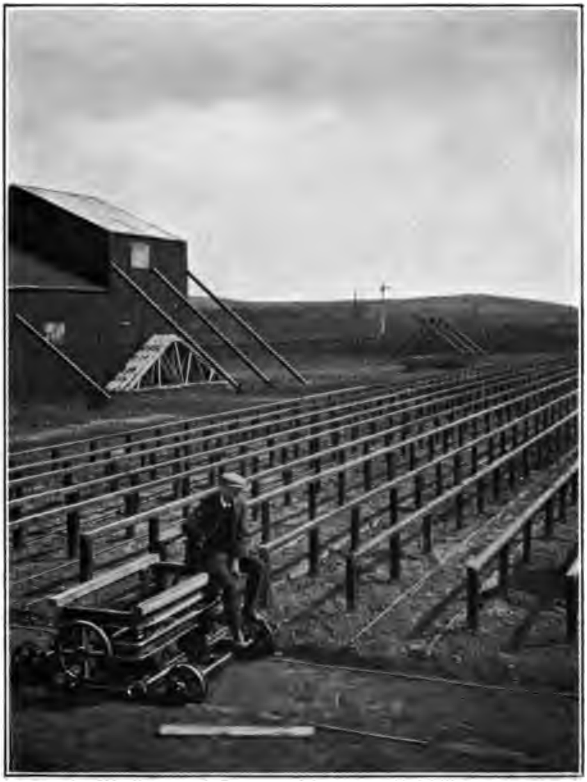

FIG. 42.—Air-drying Gantrys.

this is accomplished by means of a striker gear, under which the mould boxes have to pass at the point where the briquettes have to be ejected from the mould boxes, and the cross-head fixed to the spindle comes in contact with the striker gear which depresses the spindle and plunger and pushes out the briquettes on to the palette boards travelling beneath. The filled palettes travel along from under the machine and are lifted off and stacked on bogies ready to go into the dryer. These machines will turn out 6000 wet briquettes 6 × 6 × 4 per hour.

Dryer.—The drying, which is the most important operation of all, is done in Lennox's patent dryer with superheated moist air. This dryer can be worked at any desired temperature necessary for the operation, and can be run to dry the peat quickly or slowly as required. It consists of two drying chambers of suitable height, width, and length, into which the bogies full of wet peat or briquettes are run. The floor is fitted with grating over an endless flue or duct, and at the end of this flue is fitted a special patent heater, and at the other end is a fan, by means of which the air is circulated continuously through the heater and through the wet peat. As it takes up the moisture from the wet peat, this moist air in passing through the heater is turned into steam, and by the outlet and inlet valves and passages the steam can be let out and fresh air admitted into the chambers.

This dryer can be regulated to work at any desired temperature according to the nature of the material to be dried and the rapidity at which it has to be dried.

Fig. 39 shows the digging of the peat in the moss; fig. 40 illustrates a stack of empty palettes for air-drying the peat; fig. 41 is a view showing the patent lifting bogie, also wet peat lying ready to go on to elevator to squeezer; fig. 42 shows the extensive air-drying gantries.

Air-drying.—In this system the stacks of palettes are put out on the gantries and dry rapidly, as shown in fig. 42, where thousands can be stacked for drying on a small area of ground.

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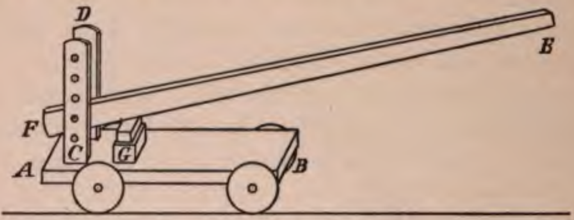

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Each box was alternately filled with peat newly dug, the lids adjusted, and the box placed in the machine at the point G. The man stood at the end of the lever, and as the box was placed in the machine he bent his whole strength and weight upon the end of the beam, and by this means a great pressure was instantly applied to the box by a single effort. Two women filled and removed the boxes. By this method a man and three women could compress about eight cartloads in a day; one man digging and the women throwing out the peat to keep this process in full operation. The peats when taken from the machine were piled like small stacks of bricks, but so arranged as to admit a free circulation of air.

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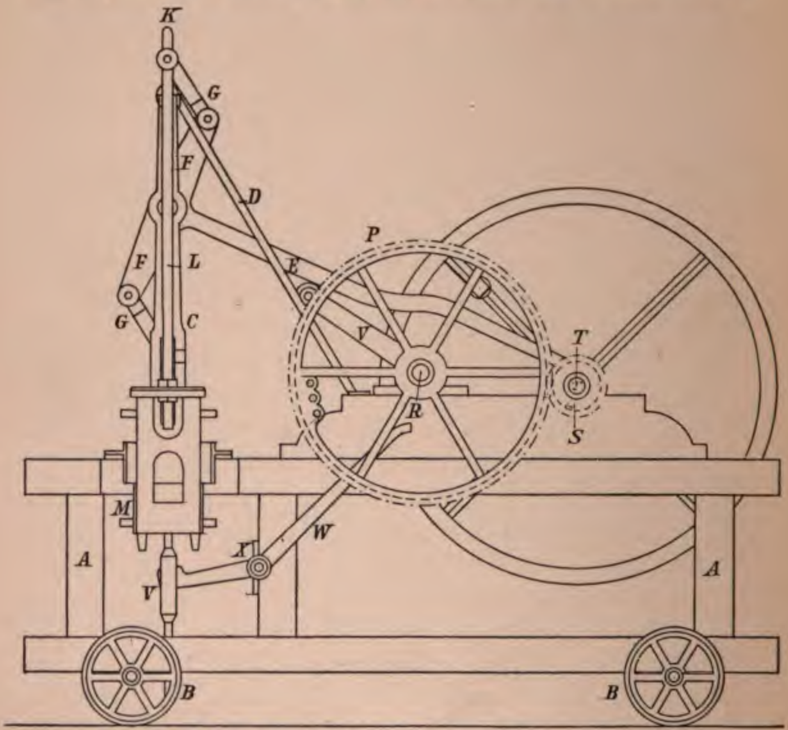

FIG. 44.—Slight's Peat Press—Elevation.

Mr Slight's machine is shown in elevation, fig. 44, and front-end view, fig. 45. This machine was intended to follow the cutting of the moss, and was therefore mounted on four l wheels. The carriage A, which was made of timber,

ran on the wheels B. The leading principle of its action was that of the bent lever. The long arm of the lever, when acted upon by a wiper, worked by a spur wheel and pinion, gave the required pressure. The second or upper bent arm of the lever was added, not as a means of increasing the power, but for the purpose of facilitating the operation. C and C were two upright frames of cast iron, supported by braces D, and completing the framework. E is the long arm of the lever; F F the heads to which are joined the two connecting links G and G; H and H are two cross-heads, jointed to the links G and G, the lower cross-heads being movable on the guides J and J, and the upper ones on the guides K and K, and both working in a vertical direction. L and L are two side-rods of malleable iron, attached at the top to the upper cross-head and at the bottom by an adjusting screw to the movable table M, which latter carries the peat moulds N and N. To the lower cross-heads are attached the pistons O and O of the mould boxes. By this arrangement of parts it is easily seen that, when the arm of the lever is lifted and brought towards a horizontal position, the heads of the lever are thereby brought into a vertical line, and their

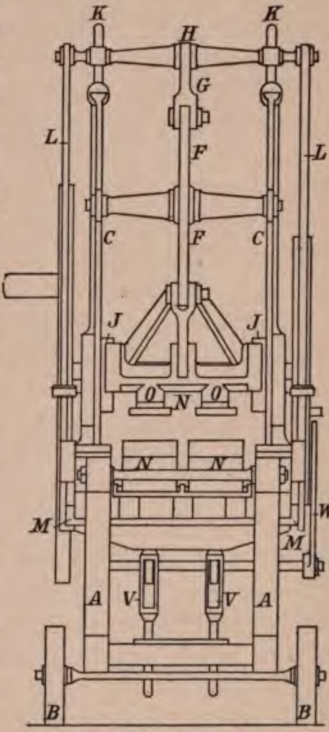

FIG. 45.—Slight's Peat Press—Front-end View.

progress has the effect, by means of the connecting links G and G, of raising the upper cross-head and the table, and of depressing the lower cross-head with its pistons O and O until the latter are brought within the moulds and the required pressure produced. The fall of the end of the lever reverses the motions, separating the pistons from the moulds to an extent sufficient to admit a charge of moss being thrown in from a shovel, when a repetition of the motion already described gives effect to the next compression. In order to increase the power of the machine, the spur wheel P, keyed on the shaft R, is introduced. The wheel is actuated by the pinion S, keyed on the shaft T. On the shaft R is also keyed the wiper V, provided at the end with a friction roller. The wiper during one-quarter of each revolution operates in raising the lever to the horizontal line, thereby giving the pressure; during the next one-quarter of the revolution it allows the lever to fall, separating the pistons and moulds, and in this position they remain during the remaining half of the revolution, thus leaving one-half of the time spent in each revolution of the wheel for the purpose of removing the compressed peat and refilling the moulds. For the greater facility of removing the peats from the moulds, the latter are furnished with false bottoms, which are attached to the rods V. These rods move vertically through guides, and are lifted by the lever W, which is acted upon by a stud in the side of the spur wheel. The lever W turns upon the fulcrum X, and to it are attached the opposite arms of the lever, to suit slots in the rods V and V. When the compression has been made, and the lever W properly adjusted, it begins to act when the wiper has moved a little way past the centre, and goes on until the movable bottoms are raised as high as the top of the moulds. One of the attendants then removes the peats with a shovel, and the continued progress of the wheel allows the lever to

fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel

in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus water is thus squeezed out, and escapes through the slots of the mould. When the pressure has been sufficiently exerted,

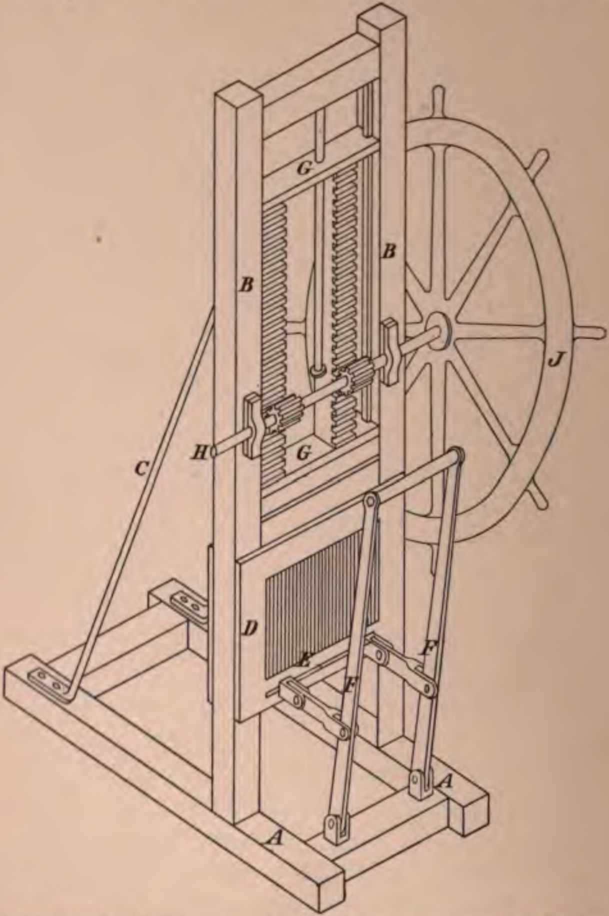

FIG. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

the sliding bottom is withdrawn, and the peat falls out ready for removal to the drying shed. As soon as the peat is discharged, the sliding bottom is returned to its place, the sliding frame raised, the mould charged with another block of moss, and the operation repeated.

At this stage of the manufacture of peat fuel, hydraulic processes were tried, and a company was formed for the purpose. The machinery consisted of a four horse-power engine, four hydraulic presses, having rams 6 inches in diameter, with appropriate moulds, each capable of pressing three blocks of peat, 2 feet square by 3 inches thick, at each stroke; and a pair of heavy edge-runners for triturating the turf previous to compression.

Mr Linning adopted a somewhat similar method, for which he secured a patent. The bog intended to be worked for the season was first drained by making ditches through it, to allow as much of the free water as possible to flow away. Next the turf was cut by an ordinary spade, thrown into a mill, and, after passing through it, was removed in wheelbarrows to the next operation. This consisted in filling wooden moulds with the triturated peat in the same manner as clay is placed in the mould when hand-made bricks are produced. From the moulding table the blocks of peat were laid out on the surface of the bog to consolidate. In two or three days they were ready to be handled and carried to a shed, where they were spread out on shelves to dry, or to a drying-house, artificially heated by means of flues, and fired by peat fuel. In a few days more the peats were ready for use. It was estimated that the cost of production of this peat fuel was approximately 5s. per ton.

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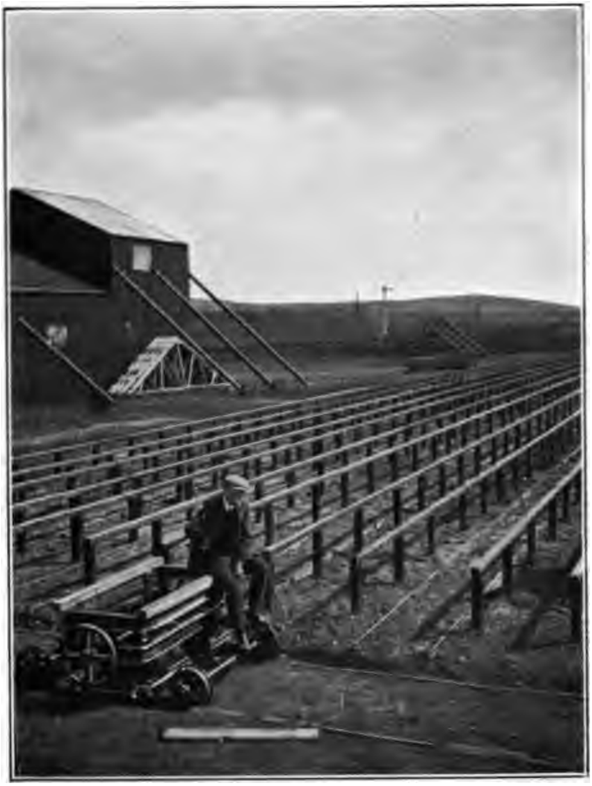

FIG. 42.—Air-drying Gantrys.

this is accomplished by means of a striker gear, under which the mould boxes have to pass at the point where the briquettes have to be ejected from the mould boxes, and the cross-head fixed to the spindle comes in contact with the striker gear which depresses the spindle and plunger and pushes out the briquettes on to the palette boards travelling beneath. The filled palettes travel along from under the machine and are lifted off and stacked on bogies ready to go into the dryer. These machines will turn out 6000 wet briquettes 6 × 6 × 4 per hour.

Dryer.—The drying, which is the most important operation of all, is done in Lennox's patent dryer with superheated moist air. This dryer can be worked at any desired temperature necessary for the operation, and can be run to dry the peat quickly or slowly as required. It consists of two drying chambers of suitable height, width, and length, into which the bogies full of wet peat or briquettes are run. The floor is fitted with grating over an endless flue or duct, and at the end of this flue is fitted a special patent heater, and at the other end is a fan, by means of which the air is circulated continuously through the heater and through the wet peat. As it takes up the moisture from the wet peat, this moist air in passing through the heater is turned into steam, and by the outlet and inlet valves and passages the steam can be let out and fresh air admitted into the chambers.

This dryer can be regulated to work at any desired temperature according to the nature of the material to be dried and the rapidity at which it has to be dried.

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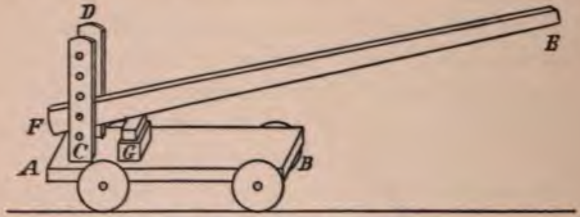

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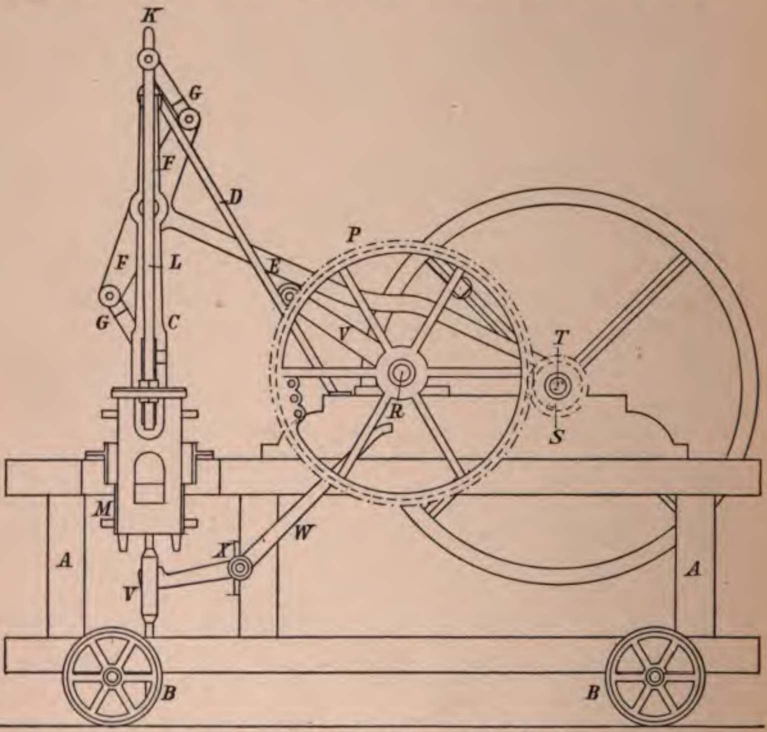

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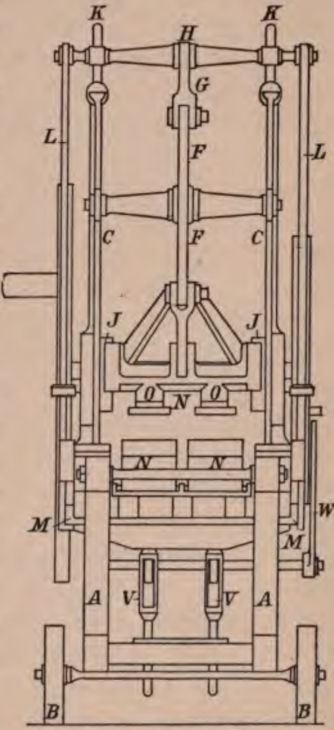

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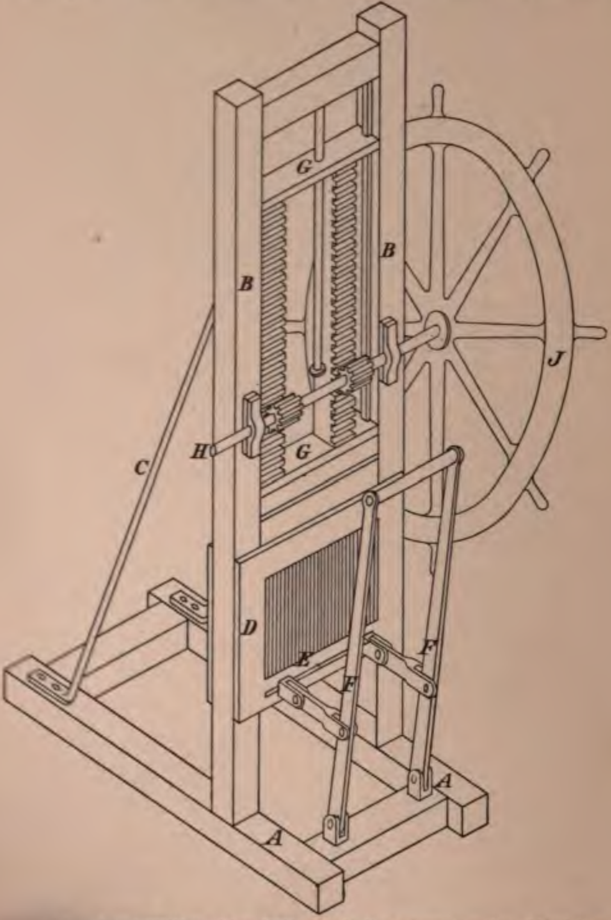

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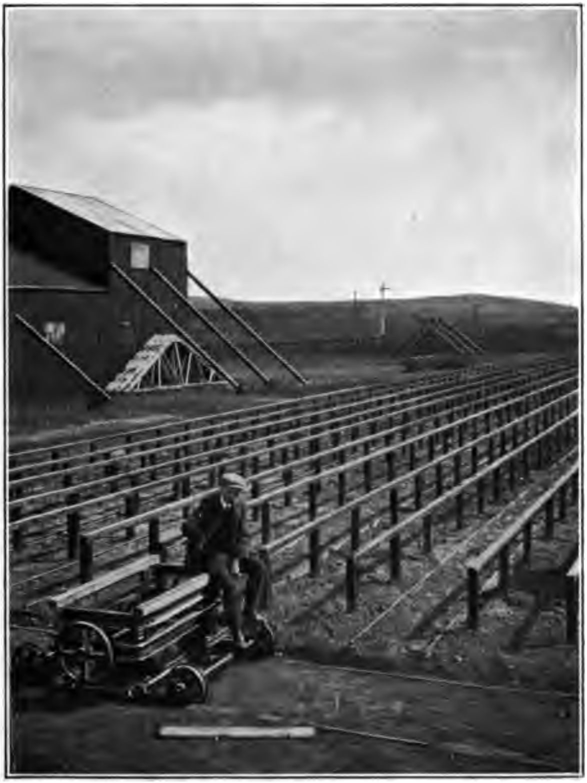

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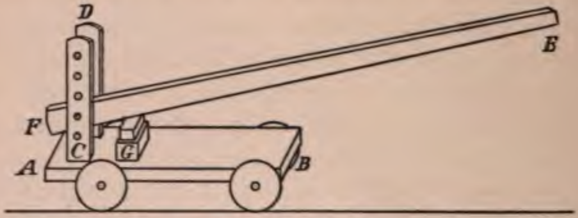

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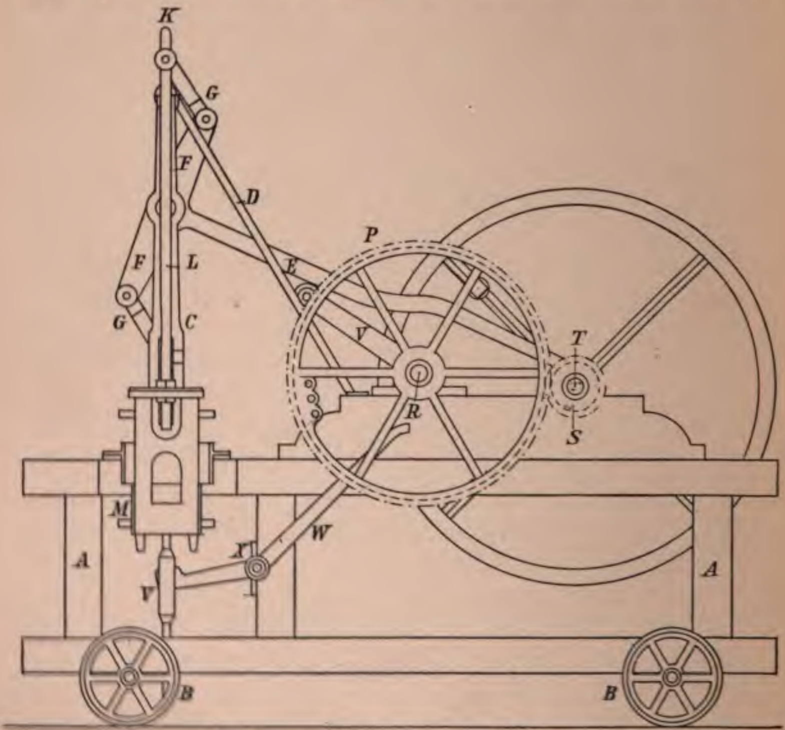

FIG. 44.—Slight's Peat Press—Elevation.

Mr Slight's machine is shown in elevation, fig. 44, and front-end view, fig. 45. This machine was intended to follow the cutting of the moss, and was therefore mounted on four all wheels. The carriage A, which was made of timber,

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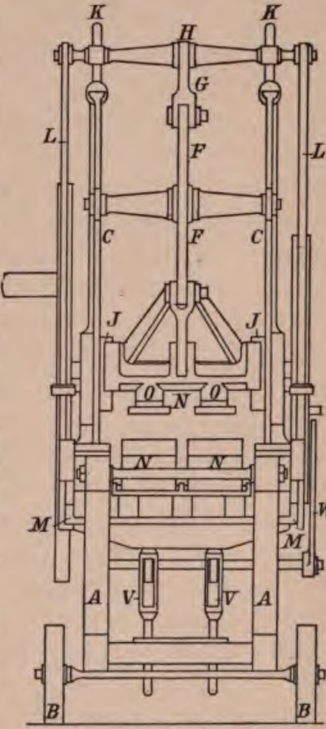

FIG. 45.—Slight's Peat Press—Front-end View.

from which they are deflected by means of a scraper on to a belt conveyor M, which carries them into the stores.

All the different machines are operated by separate electric otors. N is the steam boiler; O, the engine for working dynamo P; R is the switchboard. A pump for rging the water extracted from the peat is provided t in which the second hydro-eliminator is fixed.

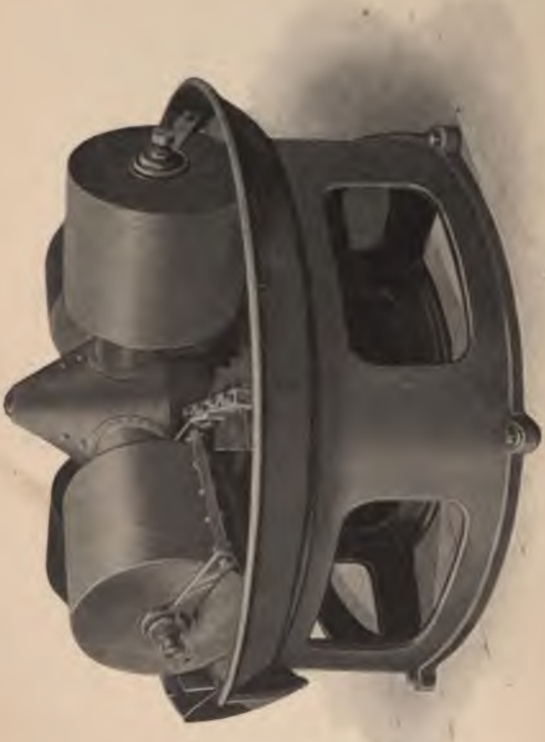

Fig. 56.—Kneading Machine.

fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel

in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus

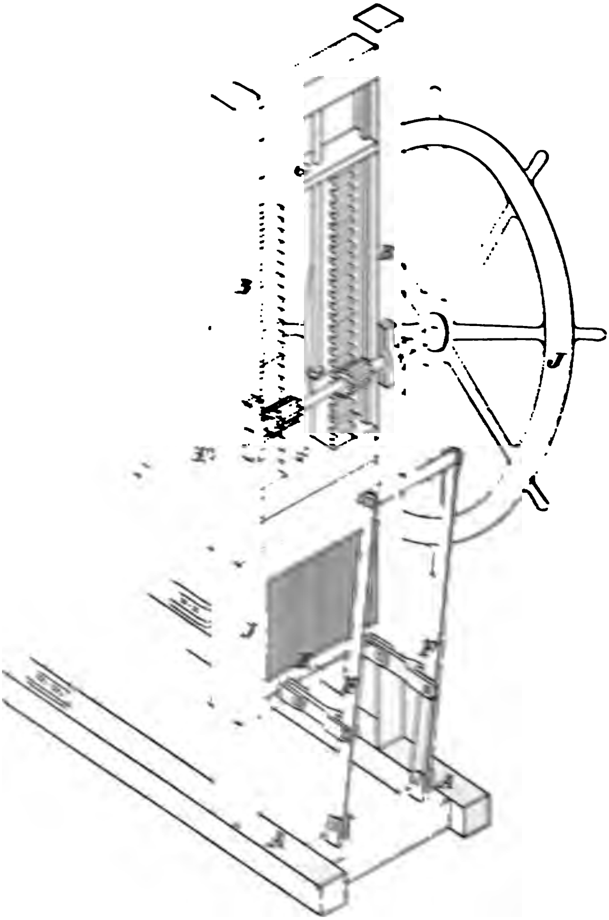

Fig. [illegible] Lord Willoughby D'Eresby's Peat-compressing Machine. Isometrical Perspective View.

[illegible] squeezed out, and escapes through the slots of [illegible] When the pressure has been sufficiently exerted,

the sliding bottom is withdrawn, and the peat falls out ready for removal to the drying shed. As soon as the peat is discharged, the sliding bottom is returned to its place, the sliding frame raised, the mould charged with another block of moss, and the operation repeated.

At this stage of the manufacture of peat fuel, hydraulic processes were tried, and a company was formed for the purpose. The machinery consisted of a four horse-power engine, four hydraulic presses, having rams 6 inches in diameter, with appropriate moulds, each capable of pressing three blocks of peat, 2 feet square by 3 inches thick, at each stroke; and a pair of heavy edge-runners for triturating the turf previous to compression.

Mr Linning adopted a somewhat similar method, for which he secured a patent. The bog intended to be worked for the season was first drained by making ditches through it, to allow as much of the free water as possible to flow away. Next the turf was cut by an ordinary spade, thrown into a mill, and, after passing through it, was removed in wheelbarrows to the next operation. This consisted in filling wooden moulds with the triturated peat in the same manner as clay is placed in the mould when hand-made bricks are produced. From the moulding table the blocks of peat were laid out on the surface of the bog to consolidate. In two or three days they were ready to be handled and carried to a shed, where they were spread out on shelves to dry, or to a drying-house, artificially heated by means of flues, and fired by peat fuel. In a few days more the peats were ready for use. It was estimated that the cost of production of this peat fuel was approximately 5s. per ton.

This peat fuel was tried in the firebox of a locomotive engine, with its train, on the Glasgow and Garnkirk Railway. The distance travelled was eight miles; and the consumption of peat on the whole journey was just double the weight of

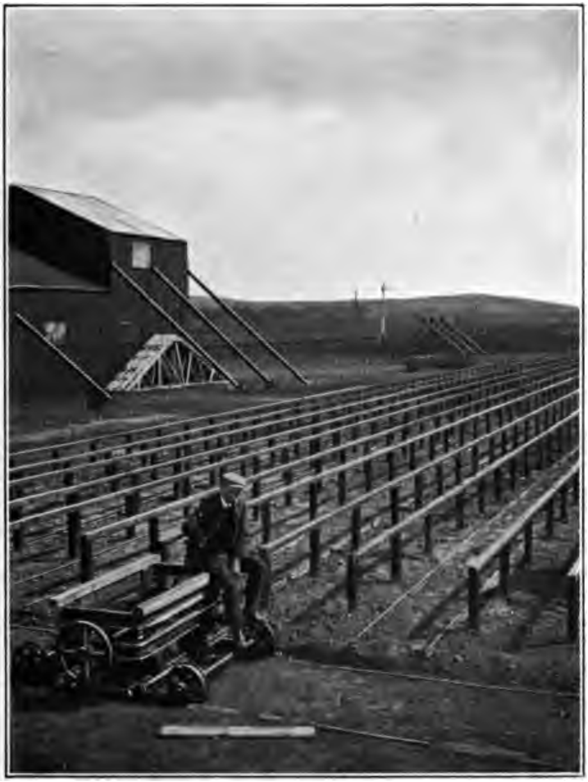

FIG. 42.—Air-drying Gantrys.

this is accomplished by means of a striker gear, under which the mould boxes have to pass at the point where the briquettes have to be ejected from the mould boxes, and the cross-head fixed to the spindle comes in contact with the striker gear which depresses the spindle and plunger and pushes out the briquettes on to the palette boards travelling beneath. The filled palettes travel along from under the machine and are lifted off and stacked on bogies ready to go into the dryer. These machines will turn out 6000 wet briquettes 6 × 6 × 4 per hour.

Dryer.—The drying, which is the most important operation of all, is done in Lennox's patent dryer with superheated moist air. This dryer can be worked at any desired temperature necessary for the operation, and can be run to dry the peat quickly or slowly as required. It consists of two drying chambers of suitable height, width, and length, into which the bogies full of wet peat or briquettes are run. The floor is fitted with grating over an endless flue or duct, and at the end of this flue is fitted a special patent heater, and at the other end is a fan, by means of which the air is circulated continuously through the heater and through the wet peat. As it takes up the moisture from the wet peat, this moist air in passing through the heater is turned into steam, and by the outlet and inlet valves and passages the steam can be let out and fresh air admitted into the chambers.

This dryer can be regulated to work at any desired temperature according to the nature of the material to be dried and the rapidity at which it has to be dried.

Fig. 39 shows the digging of the peat in the moss; fig. 40 illustrates a stack of empty palettes for air-drying the peat; fig. 41 is a view showing the patent lifting bogie, also wet peat lying ready to go on to elevator to squeezer; fig. 42 shows the extensive air-drying gantries.

Air-drying.—In this system the stacks of palettes are put out on the gantries and dry rapidly, as shown in fig. 42, where thousands can be stacked for drying on a small area of ground.

They are conveyed to the drying gantries on the Lennox patent bogie, and dropped on to the drying gantries from the lifting bogie, by two or three turns of a wheel on the bogie. One man with this bogie can lift and convey from the briquette machine to the drying gantries 10,000 briquettes in ten hours.

Pressed Peat.—The great objection to peat fuel in its natural state is its bulkiness. To obviate this, pressing of the blocks has been much resorted to. This method was first tried about the year 1821 by a Saxon gentleman named Pernitzsch, who subjected the wet peat blocks to a heavy pressure.

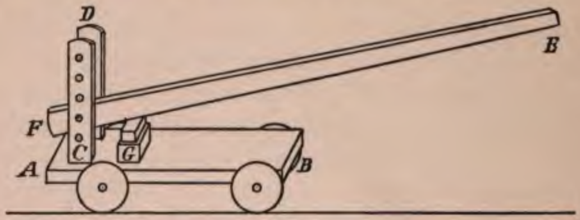

Fig. 43.—Todd's Peat Press.

The next attempt we find was made by Mr Walter Todd, of Longhope, near Hawick, who in the year 1839 constructed a very rude press of timber, illustrated in fig. 43. This machine consisted of two pieces of wood, C and D, at a distance of about two inches from one another, which were merged into the plank A B, at the end A and at right angles to A B. Between the uprights C and D was inserted a strong beam E F, 12 inches long, and secured by means of an iron bolt passing through the uprights, which latter was

provided with a number of holes to admit of raising and depressing the beam E F at pleasure.

Two boxes, one made of wood and the other of sheet iron, were employed. The wooden box was about 12 inches long, 4 inches broad, and 4 inches deep; the sheet-iron box was 14 inches long, 3½ inches broad, and 3½ inches deep. The boxes were provided with lids which just fitted them, about three inches in thickness, and heavy enough to sink into the boxes.

Each box was alternately filled with peat newly dug, the lids adjusted, and the box placed in the machine at the point G. The man stood at the end of the lever, and as the box was placed in the machine he bent his whole strength and weight upon the end of the beam, and by this means a great pressure was instantly applied to the box by a single effort. Two women filled and removed the boxes. By this method a man and three women could compress about eight cartloads in a day; one man digging and the women throwing out the peat to keep this process in full operation. The peats when taken from the machine were piled like small stacks of bricks, but so arranged as to admit a free circulation of air.

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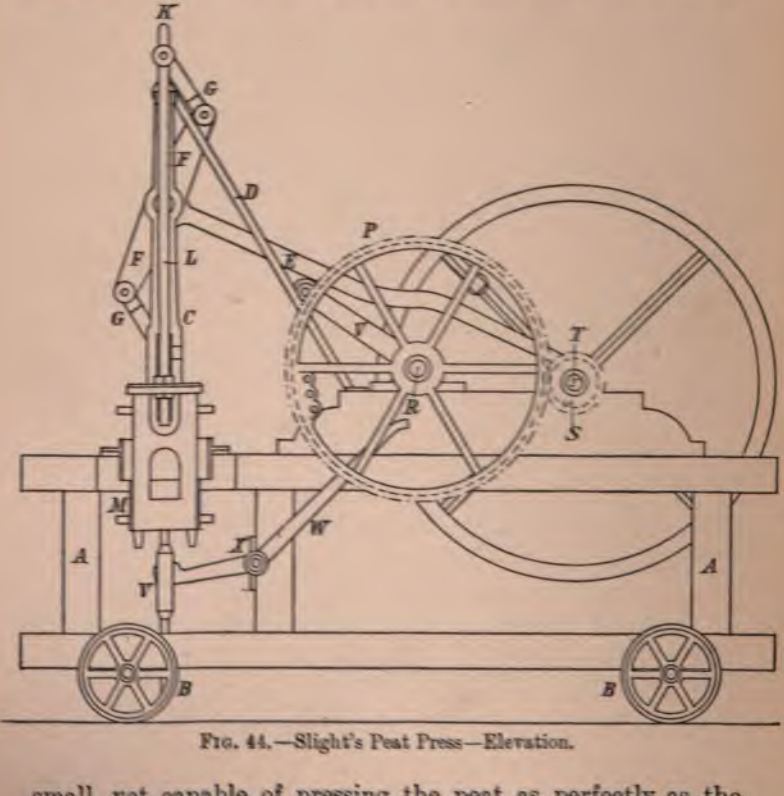

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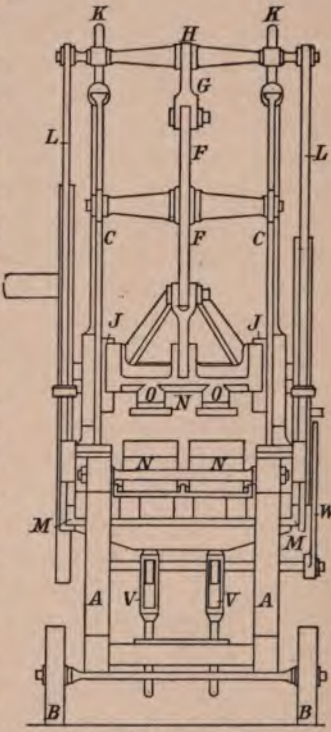

FIG. 45.—Slight's Peat Press—Front-end View.

progress has the effect, by means of the connecting links G and G, of raising the upper cross-head and the table, and of depressing the lower cross-head with its pistons O and O until the latter are brought within the moulds and the required pressure produced. The fall of the end of the lever reverses the motions, separating the pistons from the moulds to an extent sufficient to admit a charge of moss being thrown in from a shovel, when a repetition of the motion already described gives effect to the next compression. In order to increase the power of the machine, the spur wheel P, keyed on the shaft R, is introduced. The wheel is actuated by the pinion S, keyed on the shaft T. On the shaft R is also keyed the wiper V, provided at the end with a friction roller. The wiper during one-quarter of each revolution operates in raising the lever to the horizontal line, thereby giving the pressure; during the next one-quarter of the revolution it allows the lever to fall, separating the pistons and moulds, and in this position they remain during the remaining half of the revolution, thus leaving one-half of the time spent in each revolution of the wheel for the purpose of removing the compressed peat and refilling the moulds. For the greater facility of removing the peats from the moulds, the latter are furnished with false bottoms, which are attached to the rods V. These rods move vertically through guides, and are lifted by the lever W, which is acted upon by a stud in the side of the spur wheel. The lever W turns upon the fulcrum X, and to it are attached the opposite arms of the lever, to suit slots in the rods V and V. When the compression has been made, and the lever W properly adjusted, it begins to act when the wiper has moved a little way past the centre, and goes on until the movable bottoms are raised as high as the top of the moulds. One of the attendants then removes the peats with a shovel, and the continued progress of the wheel allows the lever to

fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel

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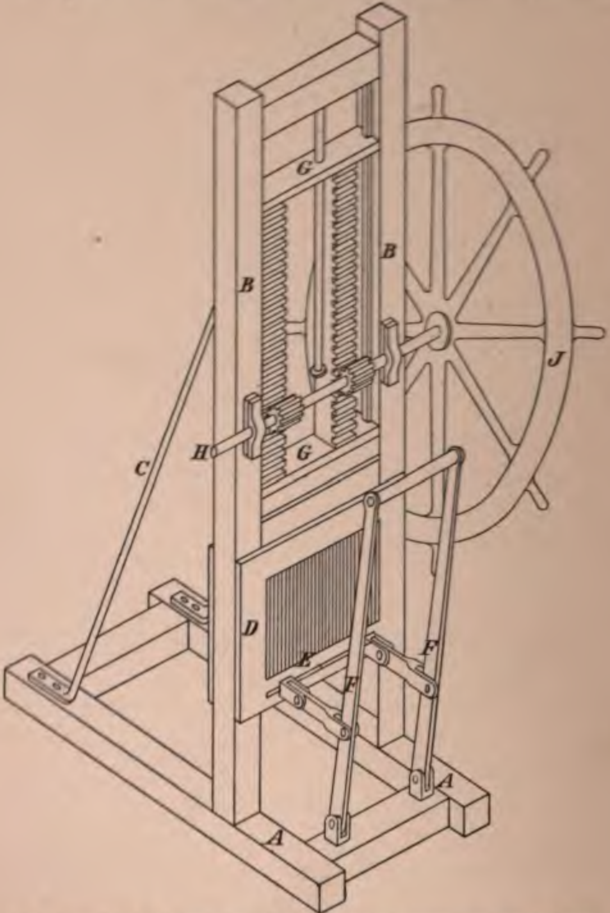

Fig. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

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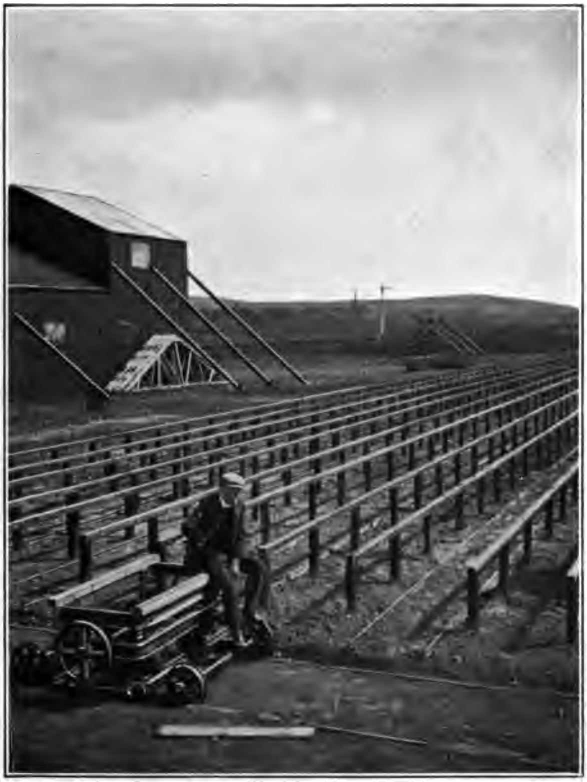

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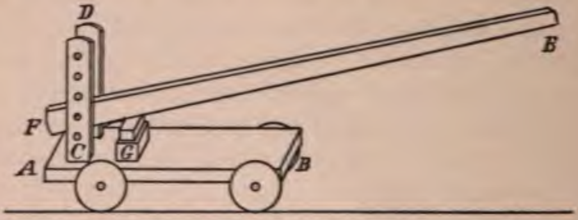

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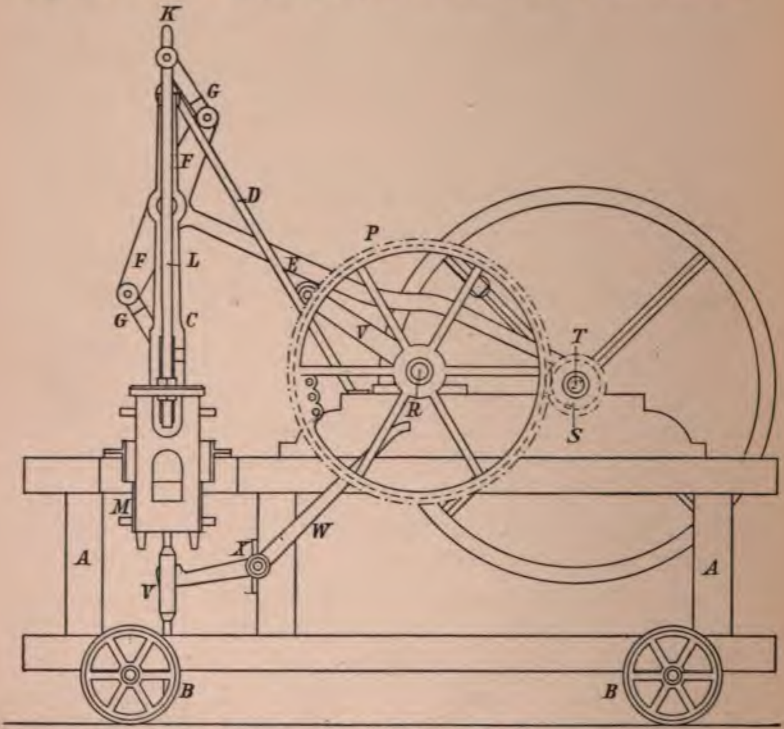

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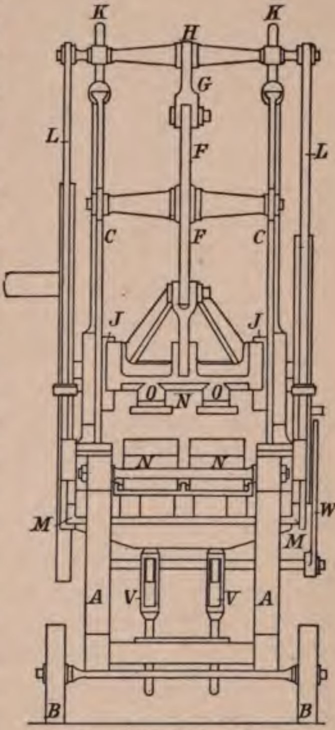

FIG. 45.—Slight's Peat Press—Front-end View.

TABLE X.

Wood charcoal	75 parts.
Coal coke	66 ,,
Charred peat	63 ,,
Bituminous coal	60 ,,
Charred wood	39 ,,
Dry wood	36 ,,
Raw peat	25 to 30 ,,
Wood with one-quarter moisture	27 ,,

During a test of peat fuel as against coal at Horwich, in Lancashire, under a steam boiler, the following results were arrived at. The test was carried out on two consecutive days, the fire having been raked out the night previous to the experiments:—

Coal got up steam to 10 lbs. pressure in two hours twenty-five minutes, and to 25 lbs. pressure in three hours. Peat fuel got up steam to 10 lbs. in one hour ten minutes, and to 25 lbs. in one hour thirty-two minutes; 21 cwt. of coal maintained steam at 30 lbs. pressure for 9¾ hours; whilst 11¼ cwts. of peat fuel maintained steam at the same pressure for eight hours.

Canadian compressed peat fuel has been tested in locomotives with excellent results, showing that the thermal value of 100 lbs. is equal to 95·13 lbs. of coal. It was also tried at the power-house of the Metropolitan Street Railway, Toronto, and gave great satisfaction. The heat produced was much greater than that of coal, but it was somewhat deficient in lasting power. It has, however, the advantages that there is no smoke, soot, dust, or clinkers, so that boilers will last much longer than if coal was used for generating steam.

As far back as 1847, peat fuel has been used on the southern section of the Bavarian Railway, and has been found both good and economical. In looking over the price, as compared with coal, we are likely to be deceived if we do not consider the cost of carriage by rail.

fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel

in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus

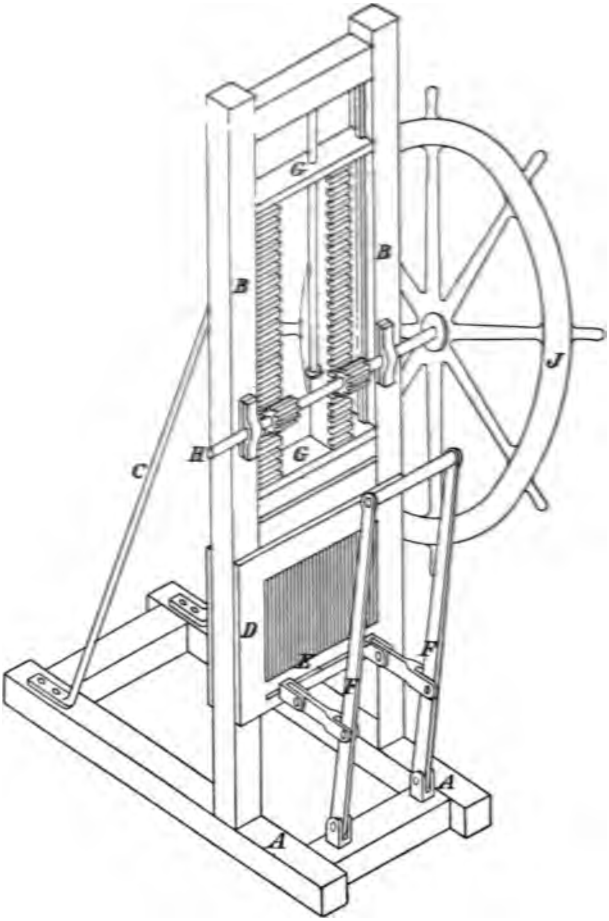

Fig. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

water is thus squeezed out, and escapes through the slots of the mould. When the pressure has been sufficiently exerted,

the sliding bottom is withdrawn, and the peat falls out ready for removal to the drying shed. As soon as the peat is discharged, the sliding bottom is returned to its place, the sliding frame raised, the mould charged with another block of moss, and the operation repeated.

At this stage of the manufacture of peat fuel, hydraulic processes were tried, and a company was formed for the purpose. The machinery consisted of a four horse-power engine, four hydraulic presses, having rams 6 inches in diameter, with appropriate moulds, each capable of pressing three blocks of peat, 2 feet square by 3 inches thick, at each stroke ; and a pair of heavy edge-runners for triturating the turf previous to compression.

Mr Linning adopted a somewhat similar method, for which he secured a patent. The bog intended to be worked for the season was first drained by making ditches through it, to allow as much of the free water as possible to flow away. Next the turf was cut by an ordinary spade, thrown into a mill, and, after passing through it, was removed in wheelbarrows to the next operation. This consisted in filling wooden moulds with the triturated peat in the same manner as clay is placed in the mould when hand-made bricks are produced. From the moulding table the blocks of peat were laid out on the surface of the bog to consolidate. In two or three days they were ready to be handled and carried to a shed, where they were spread out on shelves to dry, or to a drying-house, artificially heated by means of flues, and fired by peat fuel. In a few days more the peats were ready for use. It was estimated that the cost of production of this peat fuel was approximately 5s. per ton.

This peat fuel was tried in the firebox of a locomotive engine, with its train, on the Glasgow and Garnkirk Railway. The distance travelled was eight miles ; and the consumption of peat on the whole journey was just double the weight of trial was made with pressed peat. The generation of steam was so rapid that the engine-driver had his hand on the valve lever the whole of the journey.

Peat for Metallurgical Purposes.—For this purpose both peat and peat charcoal have been used for ages in Sweden and some parts of the Continent of Europe.

At one time the objection to its use was that the charcoal, or peat block, was too soft, so that it crushed under the weight of the iron ore; in fact, it was easily crushed between the finger and thumb. Since it has become the practice to compress the peat into briquettes, which are afterwards made into charcoal, a firm charcoal is obtained which is much superior to wood charcoal.

At some ironworks a certain percentage of coal is mixed with air-dried peat. Experiments with the mixture of peat and coal were made at the Caledonian Ironworks, Canada. The usual proportion of coal to the ore was 7 to 1, and two-thirds of the cupola was filled in the usual manner, the remaining one-third being occupied with peat and ore in the proportion of 1 of peat to 12 of ore. The metal was ready for the mould in forty minutes less than the time required when the coal was used by itself, and the iron was of a better quality. Properly dried peat has been used for the last hundred years in the so-called gas puddling furnaces in Sweden and other countries in Europe. The most suitable class of peat is the one containing the least amount of ash, sulphur, and phosphorus. If the peat contains ash consisting of carbonate of lime it can be used, the lime in such cases serving as the flux.

Some authorities consider the statement that peat does not contain sulphur to be erroneous. We admit that in some places where there is a great amount of copper in the peat-bog there is a certain amount of sulphur and phosphorus present, but, as a rule, the amount is very small; in fact, the escape of the moss, we cannot expect to exercise that agency with advantage until this be removed."

A compressing machine invented by Mr Stone is illustrated in side elevation, fig. 47, and plan, fig. 48. It consists of two cast-iron rollers A and B, the former of which is fitted with adjustable bearings D to regulate it to the thickness required, by a screw, the latter rotating in fixed bearings C. The adjustment of the roller A is done by the screw E, the nut for which has its bearing in the lever F, the fulcrum for which is provided at the top of the side frame G; the other end of the lever is connected to the long lever H, by the adjustable connecting rods J and J, the adjustment being performed by a right and left-hand screw socket; the weight L can be moved along the lever H to give suitable pressure. M M M and M are friction rollers for supporting the pressure-box N, before and after it has passed through the squeezing rollers A and B. O and O are the spur pinions, keyed upon the shaft P, these pinions gearing into the

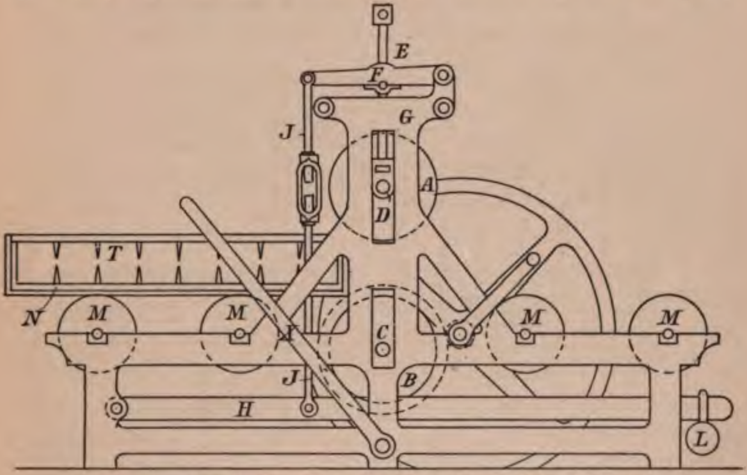

FIG. 47.—Stone's Peat-compressing Machine—Side Elevation.

in immediate contact with a spray of water, and finally passes into a flue.

At Motala Steel Works, in Sweden, peat gas has been used for the last thirty years; at first only for puddling furnaces, but subsequently for the open-hearth furnaces. Two large gas producers are constantly employed. The gas is passed to the open-hearth furnaces through a condenser to free it from some of its moisture. They have also small peat-gas producers in the rolling mills, and it has been found that the steel plates scale less when the furnaces are fired with peat gas. The peat gas is, at Motala, dearer than coal gas, but it is preferred before coal gas on account of the small amount of sulphur and phosphorus contained in it.

The peat employed in Sweden for the manufacture of peat gas has the following composition on an average:—

TABLE XII.

Carbon	60·0	per cent.
Hydrogen	6·4	,,
Oxygen	31·7	,,
Nitrogen	1·9	,,

Or, if hygroscopic water and ashes be reckoned:—

Carbon	38·2	per cent.
Hydrogen	4·1	,,
Oxygen	20·2	,,
Nitrogen	1·2	,,
Sulphur	0·0	,,
Ash	8·6	,,
Water (hygroscopic)	27·7	,,

The gas has the following composition:—

CO_2	6·9	per cent.	of volume.
CO	26·0	,,	,,
C_2H_4	0·5	,,	,,
CH_4	4·4	,,	,,
H	8·5	,,	,,
N	53·7	,,	,,

the box T; the lid will then assume an angle of from 10° to 15°, varying until the box has passed the centre of the squeezing rolls, when it will begin to assume a horizontal position and give a uniform pressure to all the blocks in the compartments. When the box has passed through between the rollers, the inside box is removed and another filled and placed in the machine and the handle turned in the opposite direction, when the new box is passed through between the rollers.

The process of pressing the peat in a wet state was soon given up, because it was found that, on account of its elasticity, the blocks again expanded and absorbed a great amount of water. This led to the class of peat known as "manufactured or machine-made peat." Two processes for pressing wet peat, besides those mentioned above, were found to give a partially satisfactory result, one being that invented by Mannhardt, and the other the Neustadt process.

Mannhardt's Process.—This process consisted in passing the wet peat between a pair of perforated rollers covered with cloth made of hair; the best cloth was made of goat's hair. The rollers were 15 feet in diameter by 6 feet 6 inches long, made of perforated iron plates, set one inch apart, and revolved about once in seven minutes. The peat was in this way deprived of some of its water and came out of the rolls in a thin sheet, when it was cut up into blocks 12 inches long by 5 inches wide and 1¼ inches thick. The block weighed about 1½ lbs. The sheet of compressed peat was divided transversely by narrow slots, which were secured horizontally round the rollers and longitudinally by circular saws, under which the peat passed as it was released from the rolls. The peats were soft when they passed away from the machine, and five or six days' air-drying was required to harden them.

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object of the former, machines of great power, and proportionately great expense, may be required. In the latter case, machines of simple construction are to be recommended, as they are not liable to get out of order, and their cost is small, yet capable of pressing the peat as perfectly as the other machine.

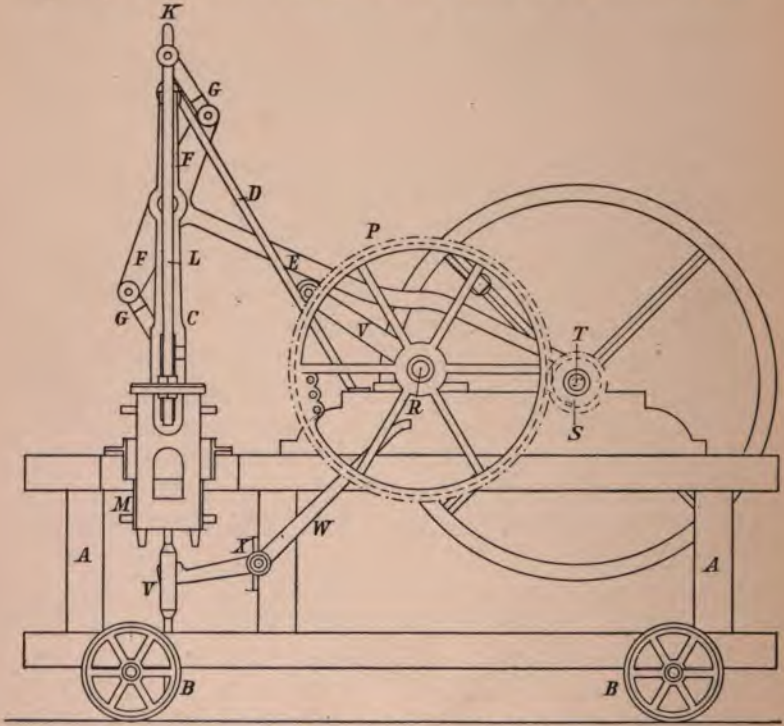

FIG. 44.—Slight's Peat Press—Elevation.

Mr Slight's machine is shown in elevation, fig. 44, and front-end view, fig. 45. This machine was intended to follow the cutting of the moss, and was therefore mounted on four small wheels. The carriage A, which was made of timber,

ran on the wheels B. The leading principle of its action was that of the bent lever. The long arm of the lever, when acted upon by a wiper, worked by a spur wheel and pinion, gave the required pressure. The second or upper bent arm of the lever was added, not as a means of increasing the power, but for the purpose of facilitating the operation. C and C were two upright frames of cast iron, supported by braces D, and completing the framework. E is the long arm of the lever; F F the heads to which are joined the two connecting links G and G; H and H are two cross-heads, jointed to the links G and G, the lower cross-heads being movable on the guides J and J, and the upper ones on the guides K and K, and both working in a vertical direction. L and L are two side-rods of malleable iron, attached at the top to the upper cross-head and at the bottom by an adjusting screw to the movable table M, which latter carries the peat moulds N and N. To the lower cross-heads are attached the pistons O and O of the mould boxes. By this arrangement of parts it is easily seen that, when the arm of the lever is lifted and brought towards a horizontal position, the heads of the lever are thereby brought into a vertical line, and their

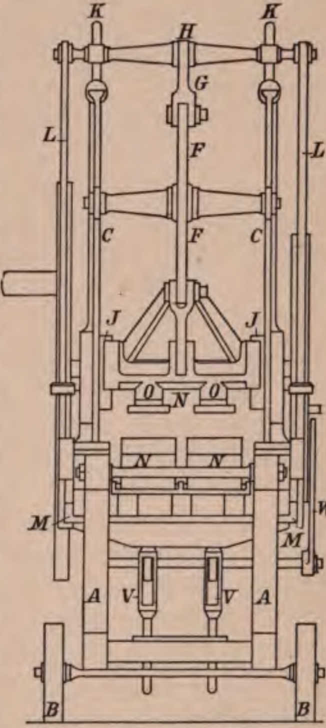

Fig. 45.—Slight's Peat Press—Front-end View.

progress has the effect, by means of the connecting links G and G, of raising the upper cross-head and the table, and of depressing the lower cross-head with its pistons O and O until the latter are brought within the moulds and the required pressure produced. The fall of the end of the lever reverses the motions, separating the pistons from the moulds to an extent sufficient to admit a charge of moss being thrown in from a shovel, when a repetition of the motion already described gives effect to the next compression. In order to increase the power of the machine, the spur wheel P, keyed on the shaft R, is introduced. The wheel is actuated by the pinion S, keyed on the shaft T. On the shaft R is also keyed the wiper V, provided at the end with a friction roller. The wiper during one-quarter of each revolution operates in raising the lever to the horizontal line, thereby giving the pressure; during the next one-quarter of the revolution it allows the lever to fall, separating the pistons and moulds, and in this position they remain during the remaining half of the revolution, thus leaving one-half of the time spent in each revolution of the wheel for the purpose of removing the compressed peat and refilling the moulds. For the greater facility of removing the peats from the moulds, the latter are furnished with false bottoms, which are attached to the rods V. These rods move vertically through guides, and are lifted by the lever W, which is acted upon by a stud in the side of the spur wheel. The lever W turns upon the fulcrum X, and to it are attached the opposite arms of the lever, to suit slots in the rods V and V. When the compression has been made, and the lever W properly adjusted, it begins to act when the wiper has moved a little way past the centre, and goes on until the movable bottoms are raised as high as the top of the moulds. e of the attendants then removes the peats with a shovel, the continued progress of the wheel allows the lever to

fall off the stud, when the bottoms fall back into their natural position to receive another charge of moss.

Shortly after Mr Slight's machine was brought before the public, Lord Willoughby D'Eresby invented a machine for compressing wet peat as it came from the bog. It is illustrated in isometrical perspective, fig. 46. It is composed of a bottom frame A A and two uprights B B, with a cross bar at top, all being made of timber, and two wrought-iron stays C and C, to support the uprights. Upon the two uprights is bolted the mould D, formed of two cast-iron plates, placed one on each side of the frame. The plates of the mould are perforated with very narrow vertical grooves or slits, one-half inch apart, and so narrow as to retain the moss, while they allow the expressed water to escape. Their width is about $\frac{1}{15}$ of an inch, widening into vertical channels, opening outwards only at top and bottom, though in the illustration they are, for the sake of clearness, shown as open throughout their whole length. A cast-iron plate is fitted to slide backwards and forwards in the slot E, and forms the bottom of the mould. It is moved by means of the levers F, jointed at their ends and to the sliding bottom by shackle joints. G and G is a movable frame composed of two racks, connected at top and bottom by the bars G and G. The lowermost of these bars is fitted to slide accurately, but easily, into the mould, the racks being acted upon by two pinions upon the horizontal spindle H, which is turned by means of the spokes on the wheel J. The rod passing through the upper bar of the frame G, with its shifting nut at bottom, serves to regulate the extent, in depth, to which the peat is to be compressed by stopping the upper bar of the sliding frame when it has made the desired descent. The process of working is as follows:—The moss is cut with a proper spade into blocks adapted to the size of the mould, into which they are thrown one at a time; while the wheel

in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus

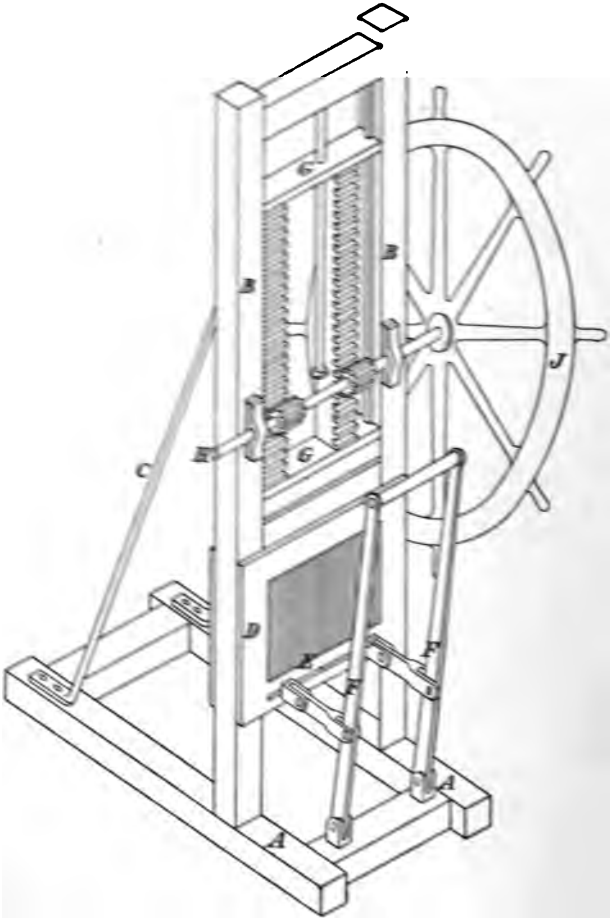

FIG. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

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the sliding bottom is withdrawn, and the peat falls out ready for removal to the drying shed. As soon as the peat is discharged, the sliding bottom is returned to its place, the sliding frame raised, the mould charged with another block of moss, and the operation repeated.

At this stage of the manufacture of peat fuel, hydraulic processes were tried, and a company was formed for the purpose. The machinery consisted of a four horse-power engine, four hydraulic presses, having rams 6 inches in diameter, with appropriate moulds, each capable of pressing three blocks of peat, 2 feet square by 3 inches thick, at each stroke; and a pair of heavy edge-runners for triturating the turf previous to compression.

Mr Linning adopted a somewhat similar method, for which he secured a patent. The bog intended to be worked for the season was first drained by making ditches through it, to allow as much of the free water as possible to flow away. Next the turf was cut by an ordinary spade, thrown into a mill, and, after passing through it, was removed in wheelbarrows to the next operation. This consisted in filling wooden moulds with the triturated peat in the same manner as clay is placed in the mould when hand-made bricks are produced. From the moulding table the blocks of peat were laid out on the surface of the bog to consolidate. In two or three days they were ready to be handled and carried to a shed, where they were spread out on shelves to dry, or to a drying-house, artificially heated by means of flues, and fired by peat fuel. In a few days more the peats were ready for use. It was estimated that the cost of production of this peat fuel was approximately 5s. per ton.

This peat fuel was tried in the firebox of a locomotive engine, with its train, on the Glasgow and Garnkirk Railway. The distance travelled was eight miles; and the consumption of peat on the whole journey was just double the weight of

coal required to fire the same engine over the same distance, but the engine travelled at a somewhat greater speed than its ordinary rate when a coal fire was used. The engineer was of the opinion that if the furnace had been properly adapted for peat fuel three-quarters would have been sufficient.

In a letter written by Mr Slight, published in the *Transactions of the Highland and Agricultural Society of Scotland* in 1838, he makes the following remarks:—"The results of all my observations on this subject may be summed up in the five following points:—

"1*st.* That peat-moss in which the vegetable structure is entirely or nearly decomposed, or that which is usually called 'black moss,' is improved little or none as a fuel by either compression or trituration, nor can its ultimate bulk be sensibly reduced by any practicable degree of compression.

"2*nd.* That brown fibrous moss is very much improved as a fuel by trituration, probably arising from some chemical action between its exposed fibres and the atmospheric air, but, in whatever way, a more compact and carbonaceous texture is produced; but that while subsequent pressure may draw off part of its water, it will neither materially improve its quality as a fuel, nor sensibly reduce its ultimate bulk.

"3*rd.* That very fibrous moss may be reduced in bulk to a small extent, will be sooner dried, and partially improved, by simple compression.

"4*th.* That there is no decidedly approved machine at present in use that will by one operation produce the greatest possible improvement in the quality of peat fuel, either on a large or small scale.

"5*th.* That since compression cannot be conducted by any means with which we are yet acquainted, without an envelope of cloth during the act of compressing, to prevent the escape of the moss, we cannot expect to exercise that agency with advantage until this be removed."

A compressing machine invented by Mr Stone is illustrated in side elevation, fig. 47, and plan, fig. 48. It consists of two cast-iron rollers A and B, the former of which is fitted with adjustable bearings D to regulate it to the thickness required, by a screw, the latter rotating in fixed bearings C. The adjustment of the roller A is done by the screw E, the nut for which has its bearing in the lever F, the fulcrum for which is provided at the top of the side frame G; the other end of the lever is connected to the long lever H, by the adjustable connecting rods J and J, the adjustment being performed by a right and left-hand screw socket; the weight L can be moved along the lever H to give suitable pressure. M M M and M are friction rollers for supporting the pressure-box N, before and after it has passed through the squeezing rollers A and B. O and O are the spur pinions, keyed upon the shaft P, these pinions gearing into the

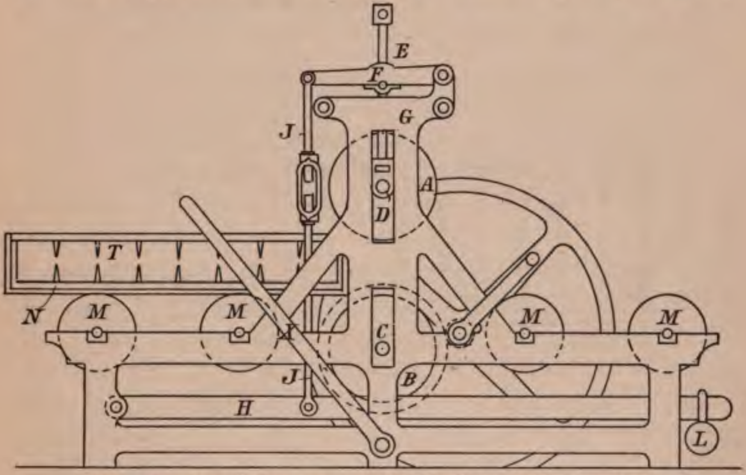

Fig. 47.—Stone's Peat-compressing Machine—Side Elevation.

wheels R and R, upon the shaft of the squeezing roller B; they also gear into two racks provided on the underside of the pressure-box N. Inside this box is provided another box T, which is divided into compartments, eight in length and two in width, making in all sixteen compartments; to form these the bottom of the box T is fitted with a number of knives. The straight sides of the knives come in contact when they are pressed together; these knives do not reach right across the box, a space being left in the middle for the dividing knives U and U to pass between the ends of them, dividing the peat longitudinally after the box has passed through the squeezing rollers. The outer box is plain and made strong. The levers X and X are for raising the lever H and removing the pressure entirely from off the pressure-box. The handle W is for giving motion to the machine, but it can, of course, be worked by any kind of motor.

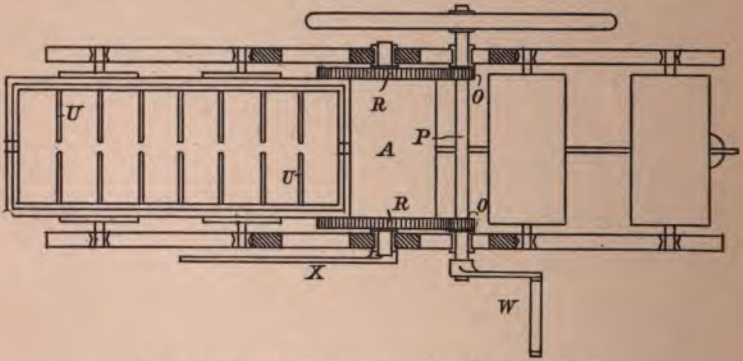

FIG. 48.—Stone's Peat-compressing Machine—Plan.

The action of this machine is as follows:—The box T is filled with peat, and then placed inside the box N, with the lever H raised and the squeezing rolls A lifted. The machine is then put in motion and the lever H let down so that the roller A will be brought in contact with the lid of the box T; the lid will then assume an angle of from 10° to 15°, varying until the box has passed the centre of the squeezing rolls, when it will begin to assume a horizontal position and give a uniform pressure to all the blocks in the compartments. When the box has passed through between the rollers, the inside box is removed and another filled and placed in the machine and the handle turned in the opposite direction, when the new box is passed through between the rollers.

The process of pressing the peat in a wet state was soon given up, because it was found that, on account of its elasticity, the blocks again expanded and absorbed a great amount of water. This led to the class of peat known as "manufactured or machine-made peat." Two processes for pressing wet peat, besides those mentioned above, were found to give a partially satisfactory result, one being that invented by Mannhardt, and the other the Neustadt process.

Mannhardt's Process.—This process consisted in passing the wet peat between a pair of perforated rollers covered with cloth made of hair; the best cloth was made of goat's hair. The rollers were 15 feet in diameter by 6 feet 6 inches long, made of perforated iron plates, set one inch apart, and revolved about once in seven minutes. The peat was in this way deprived of some of its water and came out of the rolls in a thin sheet, when it was cut up into blocks 12 inches long by 5 inches wide and 1¼ inches thick. The block weighed about 1½ lbs. The sheet of compressed peat was divided transversely by narrow slots, which were secured horizontally round the rollers and longitudinally by circular saws, under which the peat passed as it was released from the rolls. The peats were soft when they passed away from the machine, and five or six days' air-drying was required to harden them.

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Neustadt Process.—About the year 1860 loose-textured fibrous peat was manufactured by this process. It consisted in passing peat turf between ordinary iron rollers, which reduced its thickness to about two-thirds of its bulk, gave a very firm charcoal, and withstood carriage tolerably well. The peat was first cut into sods in the usual way and then fed into the rolls. As it burnt regularly, it was used for metallurgical purposes.

Hall-Björling Peat Press.—The difficulty with ordinary revolving roller machines has been to take up the wear which takes place in the gearing, as it is impossible to cast two wheels of the same hardness. This difficulty has been met by the arrangement of the gearing so that the half moulds in the two rollers can be adjusted to the thirty-second of an inch.

This machine is shown in part sectional elevation, fig. 49, and plan, fig. 50. It consists of two rollers A and A, which have their faces furnished with recesses with very small spaces between. These recesses, or cavities, are made of any shape or size to suit the requirements. The rollers are identical with one another, and the fuel is produced by the pressure obtained when it passes down the hopper B between the two rollers. To assist in drying the peat the rollers are sometimes made hollow, and steam, or hot air, admitted into them through a hole provided in the spindles. The rollers are driven by means of worm wheels C and C and worms D and D, either right-handed or left-handed as found most suitable for the position of the machine in relation to the motive power. The worm spindles are rotated by bevel wheels or mitre wheels E and E, according to the speed required for the motor. The bevel wheels or mitre wheels are again actuated by a mitre wheel keyed on the upright shaft F. This shaft has also keyed on a bevel wheel G, which gears into the bevel pinion H, keyed on the spindle J. This spindle is actuated either

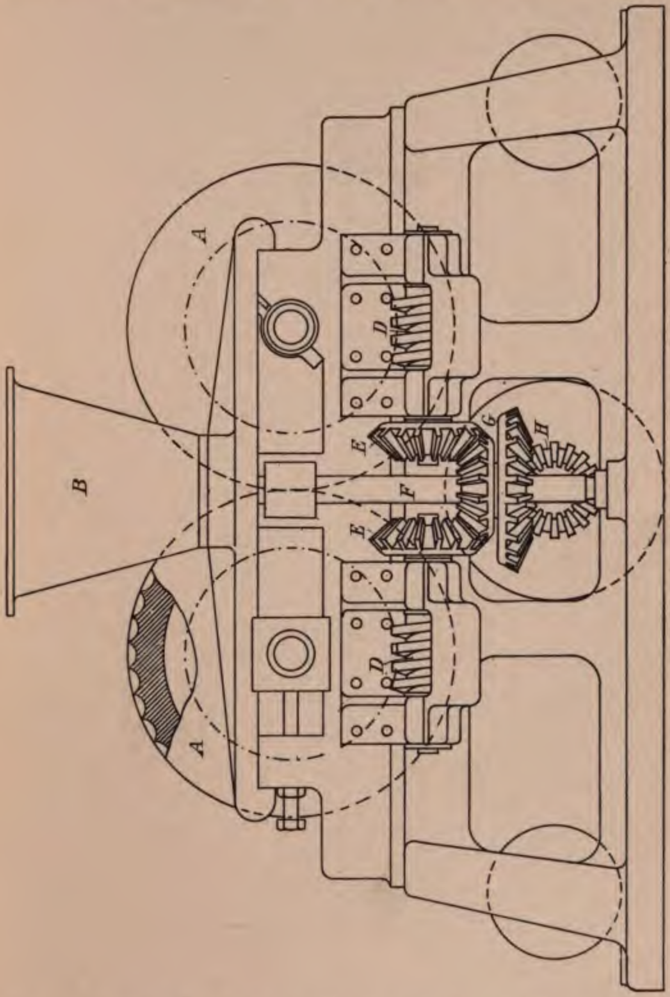

FIG. 49.—Hall-Björling Peat Press—Sectional Elevation.

by a belt pulley, or any other means, from a motor of any kind.

It will be seen that by simply shifting one of the teeth of the mitre wheels or bevel wheels E, the relative positions of the two rollers can be adjusted to the thirty-second of an

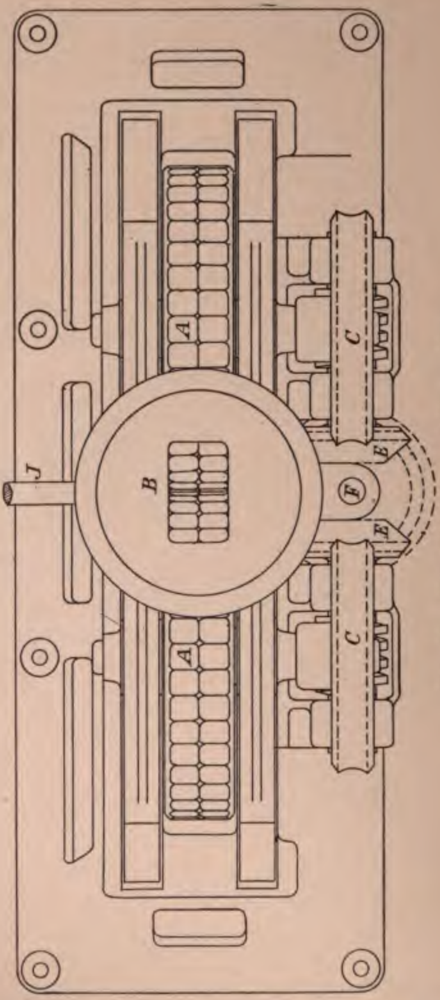

FIG. 50.—Hall-Björling Peat Press—Plan.

inch, by that means preventing unsymmetrical shapes of the pressed peat blocks.

Electrical Process for making Peat-coal.—This is the latest process for converting peat into fuel. It has been invented by Mr J. B. Bessey, and a complete plant for the manufacture of electro-peat-coal, the name given to this fuel by the inventor, has been erected at Kilberry, near Athy, Co. Kildare, Ireland, upon the estate of his Grace the Duke of Leinster, and a similar (preliminary) plant is, at present, in course of installation at the Rattlebrook Peat Works, Dartmoor, Devon, upon property acquired under lease from H.R.H. the Prince of Wales, in right of his Duchy of Cornwall.

The plant at Kilberry is capable of dealing with 300 tons of raw peat per day.

In this process the peat is taken from the bog by means of an excavator, fitted with a "grab scoop," which delivers the crude peat into small tip-wagons running over a light railway, by means of a wire-rope haulage, between the bog and the factory. The wagons, when they arrive at the factory, are emptied into a large hopper A, shown in the elevation, fig. 51, and plan, fig. 52, of the general arrangement of the machinery and buildings. The hopper is formed in the ground, from which the peat is raised by means of a belt-conveyor B into the feed hopper of a rotary hydro-eliminator C, shown in figs. 51, 52, and 53, in which the peat is subjected to a gradually increasing pressure. This hydro-eliminator is shown enlarged in fig. 54. In this machine all the "free" water is ejected.

The eliminator is continuous in its action, the wet peat passing in at the top, and the partly dried peat leaving at the bottom. The peat is then passed, by means of the conveyor D, into the electrifying machine E, also shown in perspective in fig. 55. The peat falls through a hopper

in turning round brings down the sliding frame, until its lower bar presses on the contents of the mould. The surplus

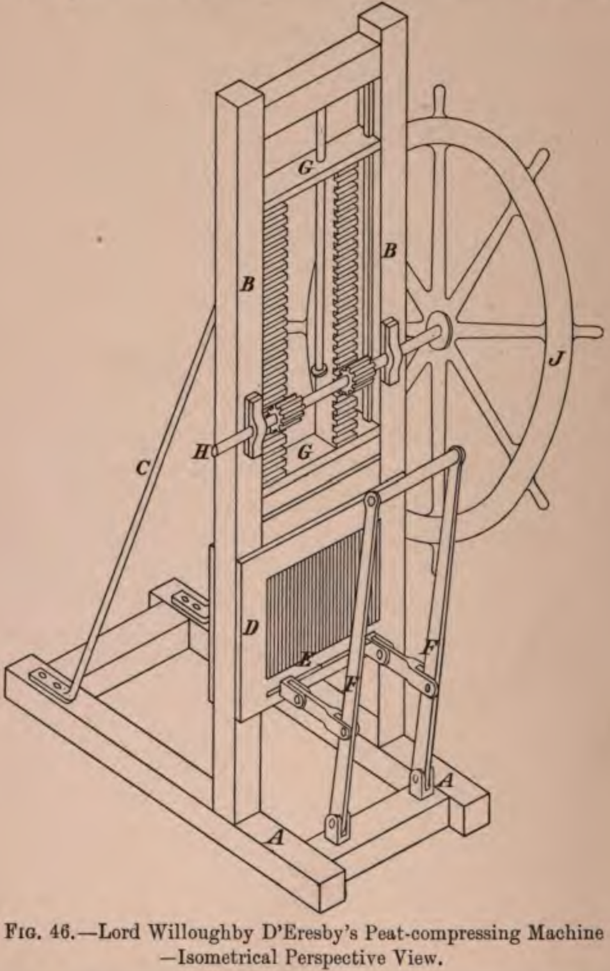

FIG. 46.—Lord Willoughby D'Eresby's Peat-compressing Machine —Isometrical Perspective View.

water is thus squeezed out, and escapes through the slots of the mould. When the pressure has been sufficiently exerted,

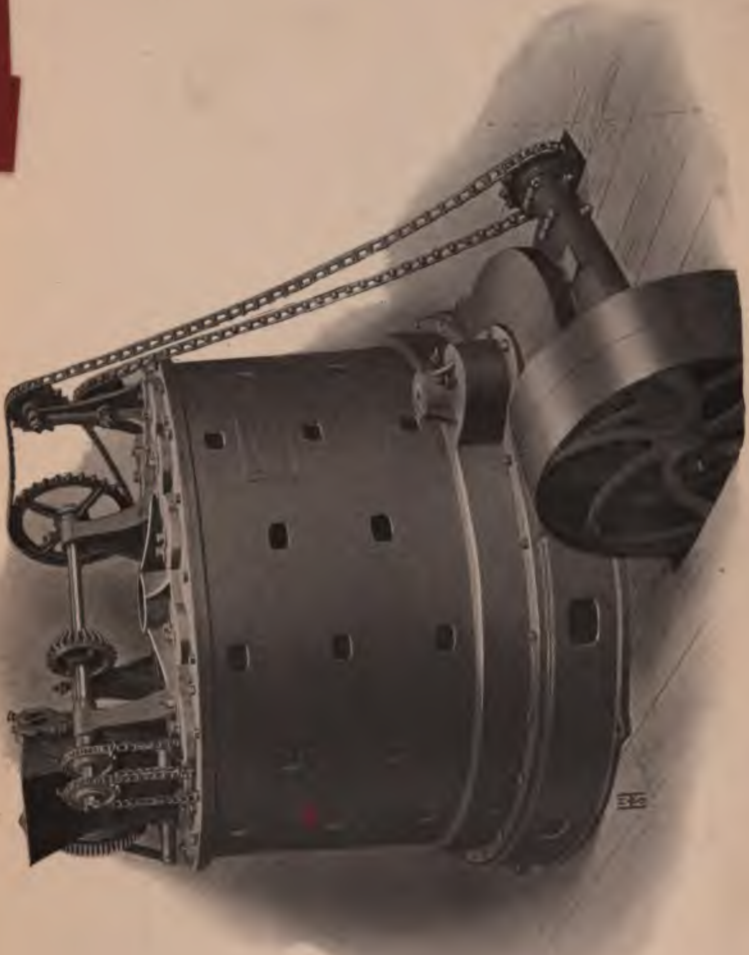

FIG. 54.—Rotary Hydro-Eliminator.

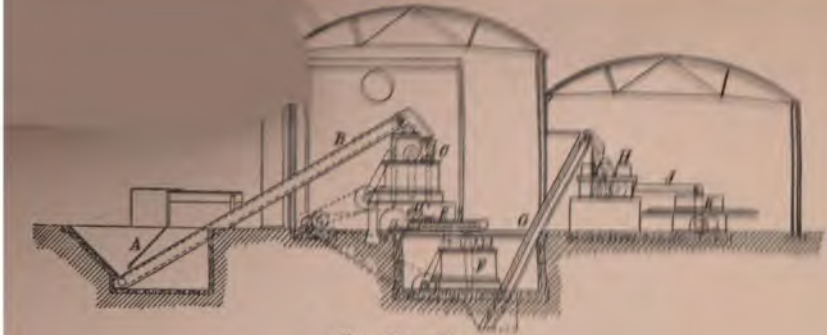

FIG. 51.—Elevation.

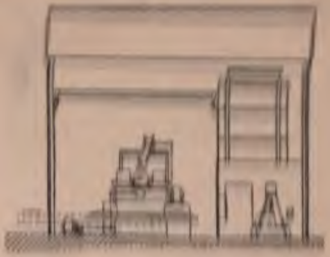

FIG. 53.—End View.

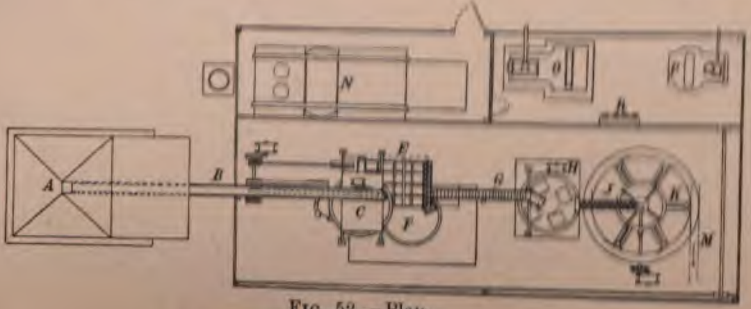

FIG. 52.—Plan.

Plant at Kilberry Electro-Peat-Coal Works.

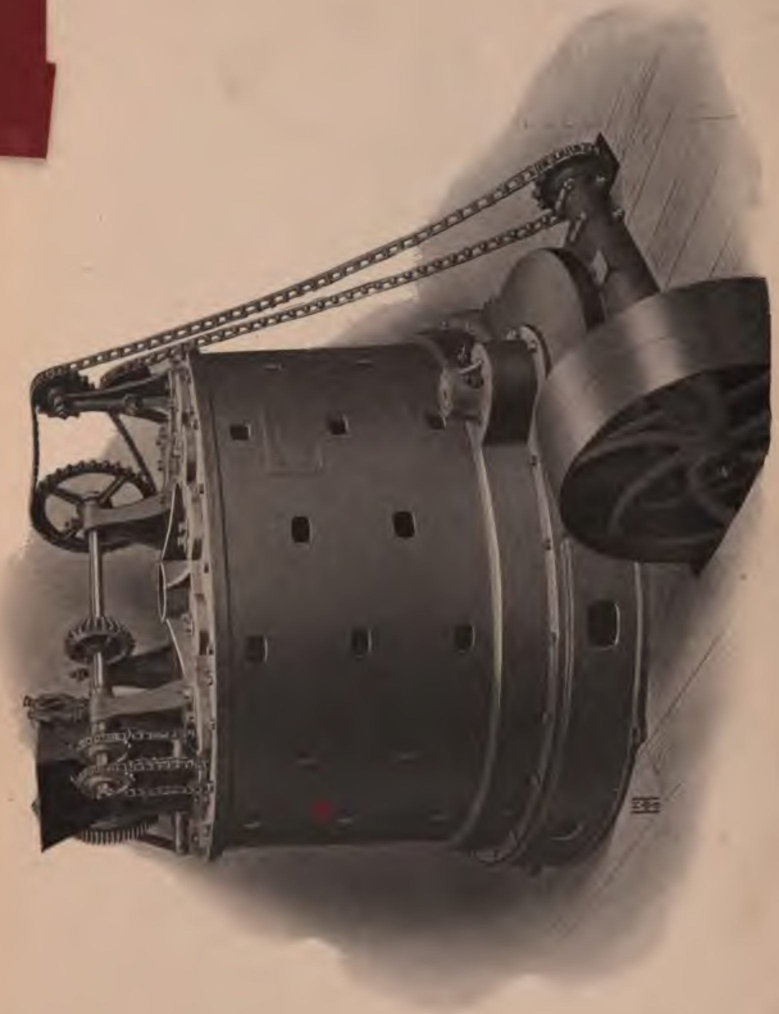

FIG. 54.—Rotary Hydro-Eliminator.

into the trough of the machine, and is pushed forward a short distance by means of a reciprocating plunger, in some-

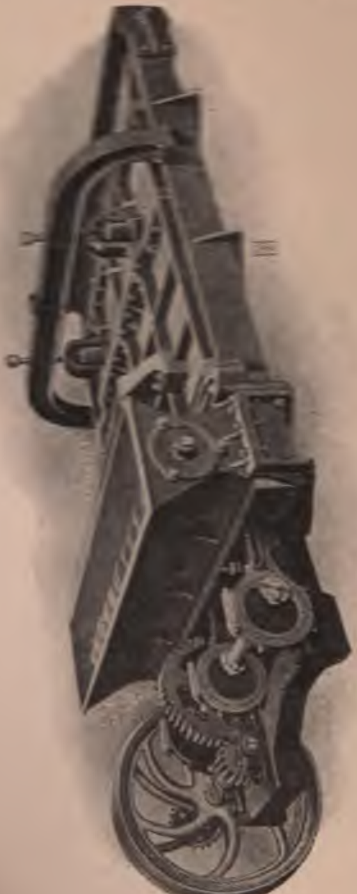

Fig. 55.—Electrifying Machine.

r manner to the “Exter” briquette press, each
ying forward another small charge, the result
ically a constant stream from the outlet. While

this is going on an alternating electric current is passing through the peat. The effect of this current is to liberate the "latent" water contained in the cells of the peat fibres, and bring the peat into such condition that the released water is easily extracted.

For the latter purpose the peat is passed through a second hydro-eliminator F, exactly similar to C, placed below the electrifying machine E.

When partly dried the peat is discharged from the second hydro-eliminator, and is lifted by the bucket elevator G into the hopper in the centre of a breaking-up and kneading machine H, in which the fibrous material is torn and worked into a plastic or putty-like mass.

The kneading machine, fig. 56, consists of a large pan, similar to that of an ordinary mortar-mill or edge runner, over the surface of which revolve four heavy runners. The peat is fed into the centre of the pan and is gradually worked over to the outer edge by means of adjustable scrapers, and is eventually discharged from the side of the pan into the screw conveyor J, which delivers the macerated peat into the moulding machine K.

The moulding machine K, shown enlarged in fig. 57, is of the open mould type on the same principle as Max Everard's briquette press, having six dies arranged in such a manner that six blocks are turned out at each revolution. The peat is next conveyed from the kneading and breaking-up machine by a screw conveyor, delivered into a hopper at the top of the moulding machine, directed into openings over each die, and on the return stroke of the plungers the peat is passed forward into a long die, from whence it emerges in the form of briquettes, several charges being in the die simultaneously, so that it is kept under pressure some time. This machine delivers 7200 briquettes per hour. They are delivered from the mouth of the dies on to a revolving table, from which they are deflected by means of a scraper on to a belt conveyor M, which carries them into the stores.

All the different machines are operated by separate electric

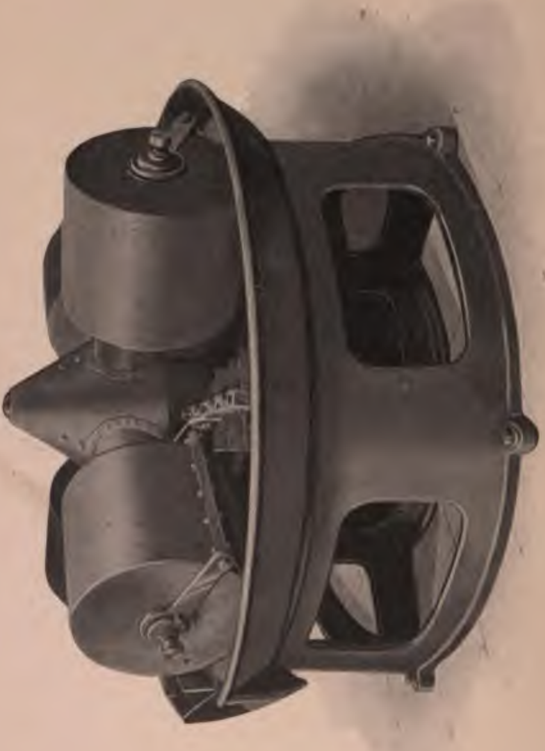

FIG. 56.—Kneading Machine.

motors. N is the steam boiler; O, the engine for working the dynamo P; R is the switchboard. A pump for discharging the water extracted from the peat is provided in the pit in which the second hydro-eliminator is fixed.

The steam for the engine is generated in a water-tube boiler, with a fire-grate specially designed for burning rough peat turf, which has been cut from the surface of the bog (hence utilising material which is generally wasted, and in many cases burnt on the bog) previous to commencing cutting out the peat proper.

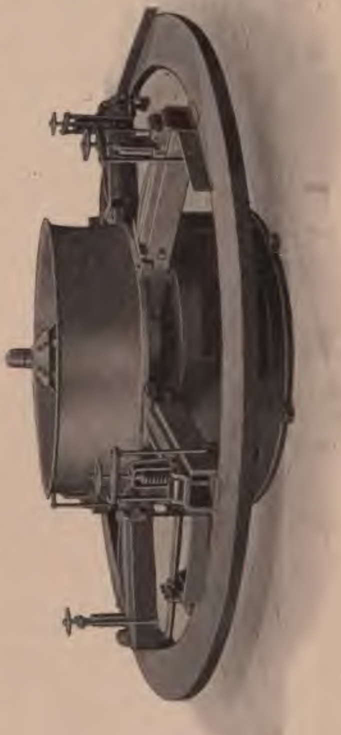

Fig. 57.—Moulding Machine.

It is estimated that the cost of manufacturing this fuel is such that it can be sold at a very large profit; this profit will, of course, vary according to circumstances, such as distance of the factory from the bog, depth at which the peat is taken from the bog, and the price of labour in the neighbourhood.

From the above description it will be seen that the principal feature is the application of electricity to free the peat from its latent water by breaking up the cells in the fibre.

The fuel produced is hard, dense, heavy, and comparatively smokeless.

Neustadt Process.—About the year 1860 loose-textured fibrous peat was manufactured by this process. It consisted in passing peat turf between ordinary iron rollers, which reduced its thickness to about two-thirds of its bulk, gave a very firm charcoal, and withstood carriage tolerably well. The peat was first cut into sods in the usual way and then fed into the rolls. As it burnt regularly, it was used for metallurgical purposes.

Hall-Björling Peat Press.—The difficulty with ordinary revolving roller machines has been to take up the wear which takes place in the gearing, as it is impossible to cast two wheels of the same hardness. This difficulty has been met by the arrangement of the gearing so that the half moulds in the two rollers can be adjusted to the thirty-second of an inch.

This machine is shown in part sectional elevation, fig. 49, and plan, fig. 50. It consists of two rollers A and A, which have their faces furnished with recesses with very small spaces between. These recesses, or cavities, are made of any shape or size to suit the requirements. The rollers are identical with one another, and the fuel is produced by the pressure obtained when it passes down the hopper B between the two rollers. To assist in drying the peat the rollers are sometimes made hollow, and steam, or hot air, admitted into them through a hole provided in the spindles. The rollers are driven by means of worm wheels C and C and worms D and D, either right-handed or left-handed as found most suitable for the position of the machine in relation to the motive power. The worm spindles are rotated by bevel wheels or mitre wheels E and E, according to the speed required for the motor. The bevel wheels or mitre wheels are again actuated by a mitre wheel keyed on the upright shaft F. This shaft has also keyed on it a bevel wheel G, which gears into the bevel pinion H, keyed on the spindle J. This spindle is actuated either

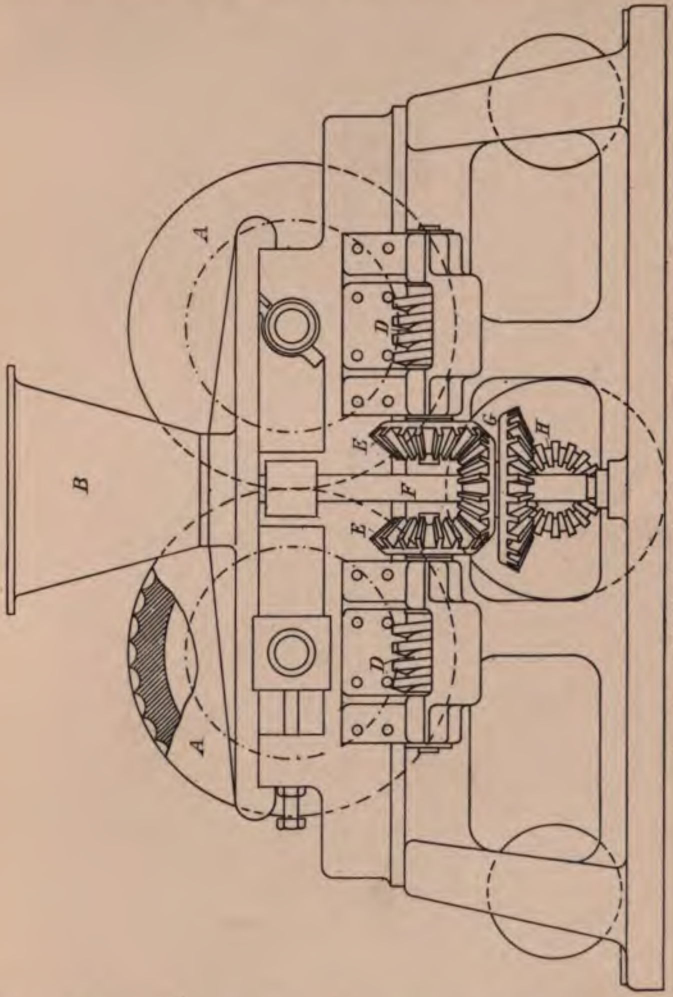

FIG. 49.—Hall-Björling Peat Press—Sectional Elevation.

by a belt pulley, or any other means, from a motor of any kind.

It will be seen that by simply shifting one of the teeth of the mitre wheels or bevel wheels E, the relative positions of the two rollers can be adjusted to the thirty-second of an

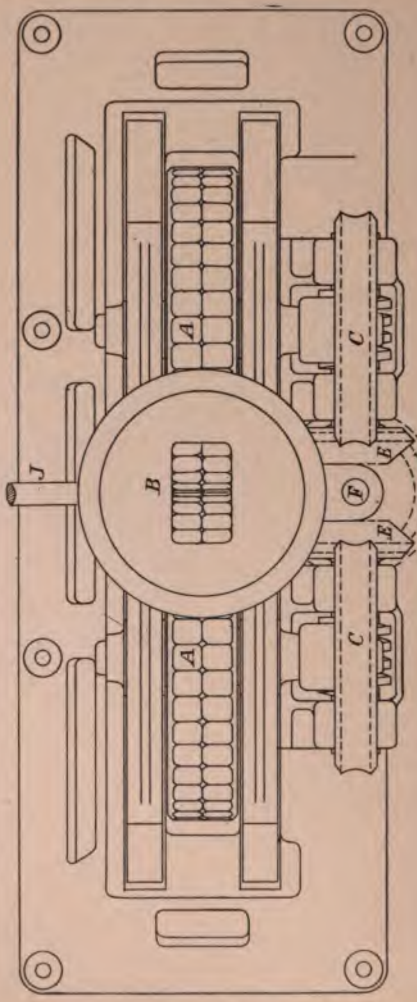

FIG. 50.—Hall-Björling Peat Press—Plan.

inch, by that means preventing unsymmetrical shapes of the pressed peat blocks.

Electrical Process for making Peat-coal.—This is the latest process for converting peat into fuel. It has been invented by Mr J. B. Bessey, and a complete plant for the manufacture of electro-peat-coal, the name given to this fuel by the inventor, has been erected at Kilberry, near Athy, Co. Kildare, Ireland, upon the estate of his Grace the Duke of Leinster, and a similar (preliminary) plant is, at present, in course of installation at the Rattlebrook Peat Works, Dartmoor, Devon, upon property acquired under lease from H.R.H. the Prince of Wales, in right of his Duchy of Cornwall.

The plant at Kilberry is capable of dealing with 300 tons of raw peat per day.

In this process the peat is taken from the bog by means of an excavator, fitted with a "grab scoop," which delivers the crude peat into small tip-wagons running over a light railway, by means of a wire-rope haulage, between the bog and the factory. The wagons, when they arrive at the factory, are emptied into a large hopper A, shown in the elevation, fig. 51, and plan, fig. 52, of the general arrangement of the machinery and buildings. The hopper is formed in the ground, from which the peat is raised by means of a belt-conveyor B into the feed hopper of a rotary hydro-eliminator C, shown in figs. 51, 52, and 53, in which the peat is subjected to a gradually increasing pressure. This hydro-eliminator is shown enlarged in fig. 54. In this machine all the "free" water is ejected.

The eliminator is continuous in its action, the wet peat passing in at the top, and the partly dried peat leaving at the bottom. The peat is then passed, by means of the conveyor D, into the electrifying machine E, also shown in perspective in fig. 55. The peat falls through a hopper

It will be seen that by simply shifting one of the teeth of

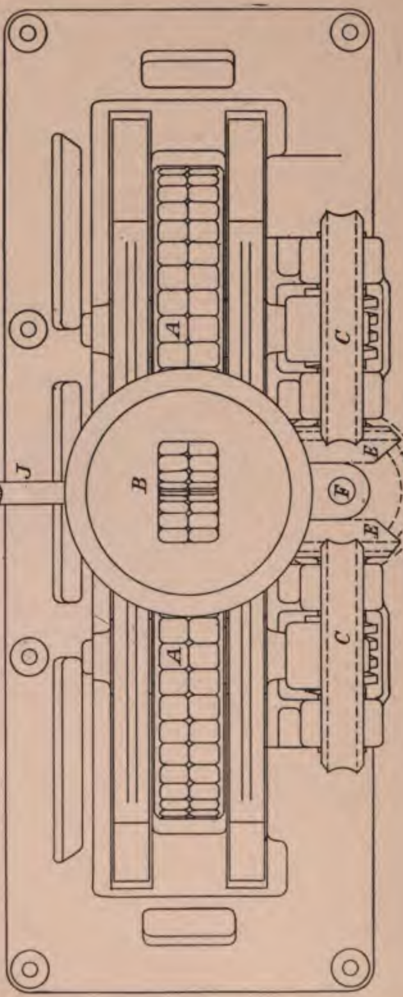

FIG. 50.—Hall-Björling Peat Press—Plan.

the mitre wheels or bevel wheels E, the relative positions of the two rollers can be adjusted to the thirty-second of an

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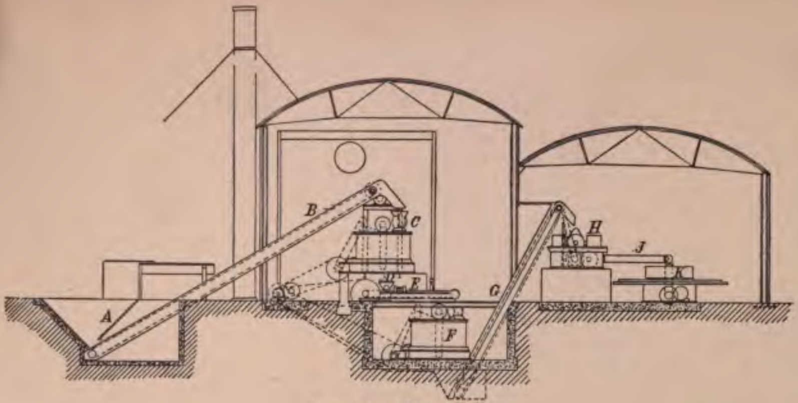

FIG. 51.—Elevation.

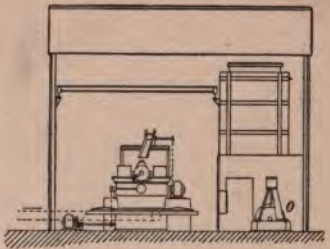

FIG. 53.—End View.

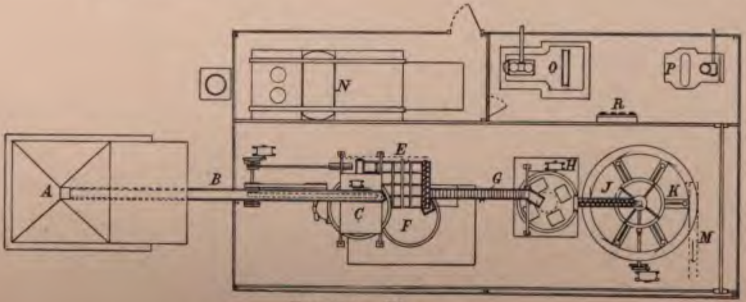

FIG. 52.—Plan.

Plant at Kilberry Electro-Peat-Coal Works.

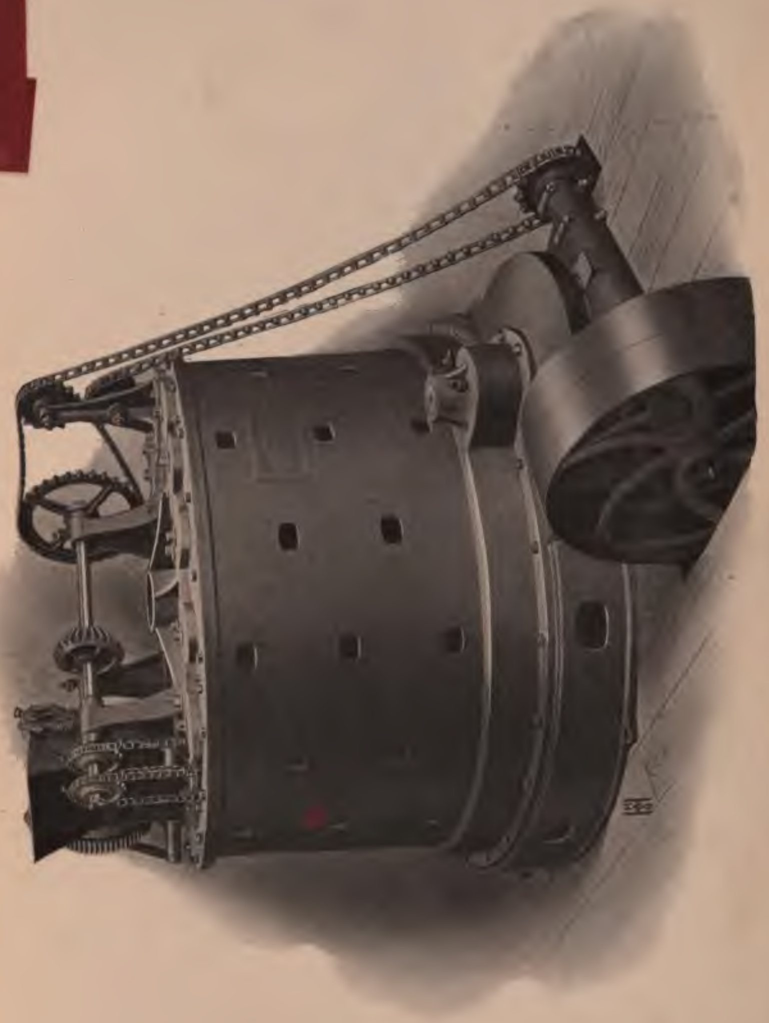

FIG. 54.—Rotary Hydro-Eliminator.

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